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THE HISTORY OF MUSIC.

Egyptian Ladies, of about the time of Moses, engaged in Music. 18th Dynasty.
From the original painting upon plaster ; taken from a tomb at Thebes, now in the British Museum.

THE

HISTORY OF MUSIC.

(Art and Science.)

VOL. I.

FROM THE EARLIEST RECORDS TO THE FALL OF THE ROMAN EMPIRE.

WITH EXPLANATIONS OF ANCIENT SYSTEMS OF MUSIC, MUSICAL INSTRUMENTS, AND OF THE TRUE PHYSIOLOGICAL BASIS FOR THE SCIENCE OF MUSIC, WHETHER ANCIENT OR MODERN.

BY

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INTRODUCTION.

It is now nearly a century since the two General Histories of Music from the earliest times, by Sir John Hawkins and by Charles Burney, Mus. Doc., F.R.S., were first published. The subsequent minor histories by Dr. Busby, by Stafford, by George Hogarth, and by others, were not offered as original, but are avowedly derived, either wholly or mainly, from the works of their predecessors.

The following is a really new History of the Art and of the Science of Music from the earliest records. The study was undertaken as an amusement, without any intention of writing; but the inducements to publish have been threefold. First, that I am now able to clear away difficulties which have hitherto been reputed as insurmountable; secondly, that this solution will afford a clue to many passages in the classics as to the interpretation of which learned men have been doubtful; and, thirdly, because I trust to be able to explain the whole system of ancient music, theoretical and practical, so that any reader may understand it. Besides this, I can give the reasons for so many

things hitherto unexplained, that I hope to make a book which will be *useful* for any one interested in music. The most ancient music is extremely simple; for the only difference between the musical notes sounded even in ancient Egypt and those of a well-tuned scale of to-day is the introduction of minor tones alternating with major, and they differ but by the eighty-first part of a string. This change made the intervals of major Thirds consonant, as from C to E on the pianoforte. In melody the former imperfection would commonly pass unnoticed, but not so in harmony.

I will first say a few words about our two musical historians, and thus show the desirability of a new history. Sir John Hawkins's complete work and Dr. Burney's first volume were printed in the year 1776. Dr. Burney's second volume was delayed till 1782, and his third and fourth were not published before 1789. In the last-named year Sir John Hawkins died, but Dr. Burney lived on till 1814; so that many now living may claim to have been his contemporaries for the last few years of his life, and among them I am one.

On the first appearance of the two histories, they met with very opposite fortunes. Popularity ran altogether on the side of Dr. Burney. For six years after the publication of Sir John Hawkins's complete work there was but one volume of Dr. Burney's to afford a fair comparison with it; and yet the world decided unhesitatingly in favour of Dr. Burney. The plan of Sir John Hawkins was too elaborate.

It combined the biography of musicians and the bibliography of music with the history of the art. Sir John's reason for attempting so much was because at that time there was no satisfactory work to be found upon any one of the three branches—at least, not in the English language.

In pursuance of this triple design, Sir John discusses the merits of author after author, and of book after book, just as he might take them in chronological order from the shelves of his extensive and valuable musical library. He adds an analysis of each work, but it is too slight to embrace some of the most important points. His history thus becomes of a very desultory character; and it involves much repetition, because the same subjects and the same branches of the art are treated on by authors of very different dates. The plan is as fatal to condensation as to continuity of subject; and thus Sir John has supplied a book of reference, containing stores of materials for history, rather than one consecutive and well-digested whole.

It was further unfortunate for him that only one volume of his rival's work should have been issued when the comparison was so over-hastily instituted. Sir John had found that he could not understand ancient Greek music; and my impression is, that he had not learnt the Greek language, which would sufficiently account for it. He therefore contented himself with giving "an impartial state[a] of the several opinions that at different times have pre-

[a] The word "statement" had not been coined when Sir John wrote.

vailed among the moderns." In this, whether from a desire to demonstrate the obscurity of the subject, or from unwillingness to trouble himself with the translation of technical words which he might not fully understand, he wrote quite unintelligibly for general readers. By passing over technical words, and even others which were not limited to technical use, he raised grave doubts as to the sufficiency of his scholarship. He anglicised Greek words; and no one but a Greek scholar could understand them, because they had not been admitted into the English language. Sometimes, indeed, he added notes to explain these words, but the notes were not always intelligible. For example, having formed a new adjective, "hemiolian," he subscribes to it:—"This is but another name for *sesquialtera*, as Andreas Ornithoparcus asserts in his *Micrologus*, lib. ii., on the authority of Aulus Gellius."—(I., 86, 4to.) But who was Andreas Ornithoparcus? The world would not know that he was a German writer of the end of the fifteenth century, whose proper name is said to have been Vogelsang. And wherefore rely upon the authority of Aulus Gellius, a Roman of the second century, for the meaning of a Greek word? It is simple enough in itself, and is to be found in every, or nearly every, treatise upon music written by a Greek. If Sir John deemed it necessary to add "hemiolian" to the English language, he should have explained its meaning to be "in the ratio of 3 to 2." Then he would have been intelligible; but to describe it by "sesquialtera" is not so.

In the same obscure style he defines a monochord as consisting of one string stretched over two "magades;" these are simply "bridges;" again, of "diastems;" meaning "intervals;" and he gives such charmingly long words, as "*sesquidecima-septima* ratio," instead of "the ratio of 18 to 17."

It is true that Sir John had ample authority for this style of writing. It had been adopted by most of the translators of Greek works upon music into Latin; and it has one great advantage, that the words are sure to be right, which might not have been the case if he or they had attempted to render them into another language. There was, however, one objection to the plan—the reader must first understand the subject, and perhaps be better acquainted with the meaning of the Greek terms than the writer. Unluckily that did not always prove to be the case; indeed, readers so well informed would naturally prefer an original text.

English musicians were not prepared for the numberless new words which Sir John incorporated into the language. One of them, Dr. J. W. Callcott, the celebrated glee-writer, turned this style of composition into ridicule by a mischievous catch, of which he wrote both the words and the music:—

1st Voice. Have you Sir John Hawkins' Hist'ry?
Some folks think it quite a myst'ry.
2nd Voice. Music filled his wondrous brain—
How d'ye like him? Is it plain?
3rd Voice. Both I've read, and must agree
That Burney's Hist'ry pleases me.

When the the third singer has sung his part, the

three take up the cross-readings in the following order :—(1), "Sir John Hawkins ;" (2), "How d'ye like him ?" (3), "Burney's Hist'ry, Burney's Hist'ry "—the last sounding like "Burn his Hist'ry! burn his Hist'ry!"

This piece of waggery was fatal to the success of a work upon which the labour of many years had been expended. Its merits remained in the background until within the second half of the present century. In 1853 Sir John Hawkins's History of Music was republished in two closely printed large octavo volumes, with the addition of posthumous notes by the author, and a few curtailments.

Dr. Burney had the triumph of a second edition of his first volume during his life; but the three remaining volumes of his history have never been, and are not likely to be, republished. There are great objections to them, to which I shall presently refer, because I cannot find that others have noticed a twentieth part of them ; but, in the meantime, as to his first volume.

Dr. Burney's system of writing upon ancient Greek music was identical with that of Sir John Hawkins, so far as reliance upon the moderns to have done all that was possible towards understanding it. Therefore the subject was not further advanced by the one than by the other, although Dr. Burney had the advantage in being at least an intelligible writer. It may, at first, appear unaccountable that, among the numbers of learned men who made the attempt to understand the

Greek system during so many ages, no one should have succeeded, especially considering that it will hereafter be shown, even to the quarter-tone, to be our modern system of music. So simple a result seems ludicrous. But this general failure is to be accounted for by the fact, that the Romans had twisted round the meanings of the Greek words in so extraordinary a fashion, that perhaps "tone" and "diatonic" are the only two which remain nearly identical in the two languages. So that, to unriddle the subject, the student had first to unlearn all that he had been taught as to the meanings of musical terms, and then to begin again, trusting only the Greek authors. No Latin treatise would avail, nor would any modern language in which musical terms had been derived through the Latin, or through the Western Church. The misuse of Greek technical language by Romans was by no means limited to music.

Dr. Burney's education was sure to include Greek, he having been a pupil at Shrewsbury School. He had copies of the treatises on music by Greek authors under his hand, in two volumes, which were printed only a century before. But he did not consider it necessary that he should study them, because he had been examined as to his knowledge of Greek music from the Latin treatise of Boethius, when he took his degree in music at the university. He therefore employed the works of the Greeks only as books of reference in case of need.

The treatise on music by Boethius, upon which

Dr. Burney relied, has proved a most unfortunate inheritance for modern Europe. Scholars of various countries have flown to it to learn ancient music, because it is written in Latin, instead of in Greek; but no one of them ever did, or could, learn from it. Boethius was unable to teach that which he did not himself understand; and he took up music simply as a branch of arithmetic. Boethius had no practical knowledge of music; he could not even tell whether a Greek scale began at the top or at the bottom. Bewildered by the two words, *nete* and *hypate* ("lowest" and "highest"), he did not succeed in discovering that they referred to length of string; and that therefore the "highest" string (in *length*) is the one which yields the lowest sound, and must be consequently at the bottom of the musical scale. And yet it is inexcusable that he should not have arrived at so elementary a piece of information, because he makes several extracts from the treatise on music by Nicomachus, and Nicomachus is one who fully explains the two words. The reader will find the explanation given by Nicomachus in one of the following pages. (See p. 36.)

Having dispensed with the only sound grammars of Greek music, by rejecting the Greek treatises, Dr. Burney's difficulties soon began. At p. 17 of his first volume he says:—

"The perplexity concerning the scale is a subject that required more time and meditation than I was able to bestow upon it;" (!) "however, I was very unwilling to leave it till I had discovered, by some indisputable rule, how to determine the question, as the few fragments left of Greek music, by a mistake in this particular,

would be as much injured as a poem, by reading it backwards. At length, an infallible rule presented itself to me, in the works of the great Euclid, who has been regarded for so many ages as the legislator of mathematicians, and whose writings have been their code."

Even this polished compliment to Euclid will not palliate Dr. Burney's utter neglect of Euclid's treatise, which is the first complete one in point of date, and the most necessary of all for beginners. If he would but have opened the pages of Euclid before he began to write, he would have been spared all his "time and meditation:" he would have found a diagram which sufficiently distinguishes the bottom of the scale from the top, without even the trouble of reading. After all, it was from that diagram that he learnt the scale, although he refers his readers to the page of text which accompanies it.

As another specimen of Dr. Burney's method of writing history, he devotes a chapter of 37 pages to discuss the question, "Whether the ancients had counterpoint, or music in parts."[a] He there collects all the "opinions" and all the "conjectures" of the moderns, both *pro* and *con*, and sums up as the constituted judge. Unhappily, neither the disputants nor the judge had first ascertained the correct meaning of the Greek word *harmonia*. Burney did not even think it necessary to include Greek definitions of *harmonia* in the chapter.

Dr. Burney had a strong preference for deriving his knowledge of the Greek authors at second-hand; and the reason was evidently because it saved him

[a] P. 108 to 145 of the second edition of vol. i., from which edition all my after-quotations are derived, unless otherwise specified.

the trouble of deciphering the contractions used in Greek books printed during the preceding century. He read Meibomius's notes upon the Greek authors, and adopted his views even too indiscriminately; so that when Meibomius trips, Burney stumbles also. Meibomius is usually a good authority, therefore any particular lapses on his part are noticed in the following pages.

Burney was, indeed, a bold man to undertake second and third volumes without the help of some one more capable than himself to read for him. He had proved in his first volume that old English printing was too much for him to decipher, and what could he do among manuscripts? The second and third volumes of his history were to embrace the period of the Middle Ages, down to the sixteenth century; therefore it could only be sought for in manuscripts, or in early printed books.

Burney's deficiencies have been so generally overlooked that I must recall the reader to his first volume (p. 235 of the first edition and p. 241 of the second). I examined both editions, to give him the benefit of any doubt. In the first line on p. 241 he states the text to be "*after the Psalmes before whyche it is prefyred,*" instead of "prefyxed;" and, only a few lines below, we read as follows:—"The same expounder informs us that the Hebrew word, *Nehiloth,* used in the title to Psalm v., *signifyeth, by interpretation,* beretrages." The last word is plainly printed "Heretages" in the original. All this is from an English Bible printed,

in 1549,[a] in the usual black letter. The capital *H* is indeed more nearly like a *B* in black letter than in modern print, and the small *x* is a little like an *r*; but, considering that milkmaids had their ballads printed in black letter, down to the end of the seventeenth century, it seems strange that Dr. Burney should not have been able to decipher it.

The reader may from this form an opinion as to the value of Dr. Burney's readings from manuscripts, when there was no Sir John Hawkins from whom he could copy, and no Twining to help him, as in his first volume. I have necessarily followed some of Burney's steps, and have found that, in manuscripts, his guessing is even more objectionable than "beretrages." There he makes harmless nonsense, but in manuscripts he frequently inverts the sense of the author. A comparison would be amusing, if it were not also provoking to observe the shallowness and the assurance of the man who has so long been allowed to impose his blunders upon us under the name of history.

When Dr. Burney proceeded to Oxford, armed with letters of introduction from Dr. Johnson, every attention was shown to him, every facility was afforded him. He dined well, he was allowed to make transcripts, after his fashion, from any of the manuscripts in the libraries, and he published his judgments upon their authors in his history. In 1869 I had also occasion to go to Oxford. It was

[a] It is the first edition of Edmund Becke's Bible, which includes Tindale's Prologues, fol. 1549. Printed by John Daye and William Seres.

for the purpose of collating a manuscript treatise on music, written in the fourteenth century, by Theinred of Dover, the only known copy of which is included in the Bodleian Library. I then observed some short rules for singing descant, which are written in old English, and are bound up with Theinred's treatise. (Bodley, No. 842, fol. 48.) At my request Mr. George Parker, one of the very able assistants in the Bodleian library, copied those rules for me; and, as they related to church music, I sent Mr. Parker's transcript to the musical periodical, *The Choir*. I made only the additions of a modernization of the language, to be printed by the side of the old text, and wrote a few lines of introduction. It had then escaped me that the rules had been published by Burney; for, after having once read his work, I did not often refer to it. The difference between the two versions is, however, remarkable. Where the directions in the text are that the voice should rise "abown" ("above"), Dr. Burney writes "belowyn" (Burney language for "below"); and where it is "levyd" ("leaved" or "permitted" to do so and so), he says it is "*denyd*." If any reader should be curious to make a comparison between two such opposite versions from one manuscript, he has but to invest twopence in the purchase of *The Choir* of the 9th of April, 1870, and to compare Mr. Parker's transcript with that of Burney, at p. 434 of his second volume. Burney states these rules to be the "*compositio* Ricardi Cutell de London"—perhaps an ancestor of the famous Captain Cuttle—but

the manuscript attributes to him only the *operatio*, the "copying," instead of the "composition." So, again, with Theinred's treatise; although Burney quotes only the first line of the Latin, he states it incorrectly. Instead of "Quoniam musicorum de his cantibus frequens est *distinctio*," the last word should be "*dissensio*." Well might he complain of "the barbarism and obscurity of the Latin," as he read it (p. 397); but this is only another proof of his unfortunate incompetence.

If Dr. Burney had been able to contribute a few examples of ancient music, and to present them in an intelligible form, he would have done something towards history; but he could only copy specimens from others. "The study of ancient music," says he, in his Preface, "is now become the business of an antiquary more than of a musician;" and he, at least, would not claim to be an antiquary. It might have been as well if his sense of deficiency in that respect had acted as a check upon his flippant judgments of old musicians whose works he could not read; but then he would have lost occasions for smartness, upon which he relied as a great attraction in his writing.

Although Dr. Burney was admitted as a Fellow of the Royal Society, he does not exhibit great qualifications either in musical or in acoustical science. At p. 445 of his first volume, he says:—"The compound interval, for instance, of the 8th and 4th, though undoubtedly concord, they" (the Pythagoreans) "would not admit as such." Dr. Burney

is here peculiarly unhappy in his correction of the Pythagoreans. Reader, try the Burney concord; strike C, C, F, on the pianoforte. Now take away the lower C, and substitute F for the base. That is what other people call concord, and the first they term discord. Burney is demonstrably wrong, because no such sound as our F can ever arise from the root of C. This is unequivocally proved in the following chapter upon the basis of the science of music. No concord can arise between any two sounds if they cannot be traced to one root.

To cultivate a lively style and to follow the fashionable tastes of the day were Dr. Burney's two ideas of the desiderata for a history of music. His direct model was his admired J. J. Rousseau, as evinced in Rousseau's clever and caustic, but shallow and unjust writings upon musicians and upon music. The Troubadours of Provence, and Italian music, especially Italian opera, are Rousseau's all but exclusive themes of praise; and he raises them to greater prominence by an undue disparagement, if not a sweeping condemnation, of the music of other countries. Burney is, in some cases, a direct plagiarist from Rousseau; but, as often happens with imitators, he exceeds his original. In order to appear very smart and very clever, Dr. Burney does not scruple to misstate the words of an author in order to make jokes at his expense, and to be thought to correct him. I have given so many proofs of his habit of perversion in my Introduction to *Popular Music of the Olden Time,* that, although those quotations are

limited to one subject, they afford sufficient evidence of the fact, without further devotion of space.

Unfortunately, our two historians were equally unable to judge of the age of early manuscripts, and neither the one nor the other took the precaution of enquiring from those who were skilled in paleography. Thus they have inverted the course of history, and sometimes in a curious manner. An important manuscript, written in the first half of the thirteenth century, is postponed to the fifteenth, and one of the second half of the fifteenth is antedated as of the fourteenth century. A new history would therefore be necessary, if it were only to re-work the old materials, but the whole face of those times is now changed by new evidence.

It is unfortunate that Dr. Burney's History of Music should not have been adequately tested before it was adopted as an authority ; for, since his death, we have been too often treated to lectures upon music which are simply cut out of his work. This is the most melancholy part of the affair. Every allowance may be made for a man who fails in some of the very numerous requirements for histories of music. The various languages, ancient and modern, the obsolete technicalities within those languages, the obsolete notation in which ancient music is written, the chronology of manuscripts and their decipherment, the necessity of a grounding in general as well as in particular science, the wide extent of general reading required, mastery of the subject to draw sound conclusions, and, finally, the unremunerative

character of the amusement, or the task, as the chance may be, will afford some excuses; but it would be difficult to find any for one who seeks, by a perversion of texts, to gain undue credit for himself as of superior ability to their authors.

Histories of music require one who is willing to devote time to them, especially for the earlier portions. But, when once the foundations have been securely laid, the great difficulties of the task are overcome, and then abler men, who have made special studies upon particular branches, may well step in and raise the general standard of knowledge. Hitherto we have lost those advantages for want of the secure basis to start upon. I hope to have at last succeeded in that fundamental part, and to submit an ample number of good authorities in proof of it. Henceforth how simple and continuous is the chain. Commencing from our modern end, note first the long or white keys of the pianoforte. Their arrangement was copied from the keys of organs. Modern Europe derived organs originally from the Greeks. The white keys in question, our A, B, C, D, E, F, G, form the "Common" Greek scale, conveyed to us through the organ. The intervals of tone and semitone will hereafter be proved to be precisely the same in every Greek "diatonic" scale.

Next, the Greeks and Romans derived their organs from ancient Egypt. In evidence of this, and carrying the proof even to the very action of the key, we go back to an extant work on Pneumatics, written in Greek in the third century before the birth of

Christ, by Herōn of Alexandria. It includes a then new kind of pneumatic organ, one to be set in action by a windmill, as well as a full description of the organ called hydraulic, which had been recently invented by Ctesibius, the Egyptian barber of Alexandria, and the reputed teacher of Herōn. After translating Herōn's description of the latter, I made, with the assistance of a friend, a working model sufficient to test the principle of the hydraulic organ, according to Herōn's directions, and it answers perfectly. By a little consideration, I find that the especial object, and the one advantage of his invention is, that it prevents the possibility of overblowing the instrument so as to injure it. If too much pressure be applied to the bellows, the surplus air will escape through water before it reaches the wind-chest, and so the instrument will remain uninjured.

With this information, we go back to the history of the ordinary pneumatic organ, blown like those of to-day, by bellows directly into the wind-chest. Through an oracle referred to by Herodotus, I find evidence that the ancient Greek "pairs of bellows" were precisely the same as those which we see depicted in Egyptian smithies on the paintings in the tombs, one of which is here copied to illustrate them. Next, that those identical "pairs of bellows" are to be seen sculptured upon Roman organs as late as the fourth century of our era. The blower stood upon the bellows, and exhausted them alternately by throwing his weight first upon one leg,

and then upon the other. Therefore the pressure upon the wind-chest was the weight of the man, whether the organ was large or small. But in the hydraulic organ the pressure could be regulated, not only by making the receiver of a size in proportion to the instrument, but even to the nicety of a pound, by the proportionate weight of water applied; therefore, at once, the advantages of the Egyptian barber's improvement become evident.

After Herōn, I found no difficulty in translating the description of a double-acting hydraulic organ, as given by Vitruvius about 20 years B.C., although his description has been reputed to be unintelligible. Neither Sir John Hawkins nor Dr. Burney would attempt it, and the translations of architects, Newton, Gwilt, and others, are really unintelligible.

Then turning to another subject, I found, through a quotation upon an astronomical computation, that the number of notes in the Egyptian musical scale was precisely the same as in the Greek, including the three Greek scales, diatonic, enharmonic, and chromatic. This quotation had been open to all preceding readers of the Greek authors upon music, but its importance had passed unnoticed. The evidence is altogether in accordance with my expectation, because no Greek writer alludes to any difference between the Egyptian and Greek systems of music, although the best Greek works upon the science of music, saving the Problems of Aristotle, were written on the soil of Egypt, and the Egyptians were undoubtedly the teachers of musical science to the

Greeks. It effectually disposes of claims set up by comparatively late Greek writers for their countrymen as originators of the enharmonic and chromatic scales.

Then next to the Chaldæans, or learned men of Babylon, and again I find, through an astronomical comment which, as usual, supposes the motion of the planets to be regulated by musical intervals, and thus to make everlasting harmony, that the Chaldæans had the same musical intervals of Fourth, Fifth, and Octave, as the Egyptians. By that means we may identify the musical systems of the two great nations between which the Hebrews were situated, and with whom they had frequent communications. Next, as to the musical system of the Hebrews. There I should have been at a loss, through not understanding the Hebrew language. I could but have referred to Jewish writers who flourished under the empires of Greece and Rome, and who wrote in Greek—such as Philo Judæus and Josephus—and have said that they make no mention of any differences of system, although they not infrequently refer to music. Also that the musical instruments named in the Book of Daniel, if Jewish, are wonderfully like Greek, and that there are lyres of unmistakable Greek forms upon Jewish coins. But here my learned friend, Dr. Ginsburg, one of the committee for revision of the Old Testament, assists me, and enables me to state, upon his authority, that the names of the musical instruments in the Book of Daniel are not derived from Hebrew

roots; and, further, that he has found proofs in the Talmud of the use of the hydraulic organ by the Jews. So henceforth we may fairly conclude that we have at last arrived at the musical system of ancient Asia, and that it is our A, B, C, D, E, F, G.

Then the interesting question arises, "Did the ancients practise harmony?"—Undoubtedly they did, even at the time of building the Pyramids of Egypt. It is not a matter of doubt, but a mathematical certainty. This is shown in the following chapter on Egypt, and the reader will find, towards the end of this volume, an Egyptian caricature of a quartet concert at the Court of Rameses III., in which the King plays, not first fiddle, because the Egyptians had not arrived at the use of bowed instruments, but, instead of it, he sounds the lyre.

All this tends to show the *vast* antiquity of the science of music; also what an open and neglected field there has been for any diligent enquirer into musical history who started with an elementary knowledge of the principles of sound.

Now, in another direction, as to the changed meanings of technical words. Let us take the two last named, "enharmonic and chromatic." The Greek enharmonic scale is the diatonic A, B, C, D, E, F, G, A, minus the Fourth and the Seventh. If we count it from the key-note upwards, as in modern scales, it is our A, B, C, E, F, A. As to the quarter-tones of this scale, they were merely added to utilize the two unemployed strings, D and G. Quarter-tones

both were, and are, insusceptible of harmony, and, therefore, they could only be used as grace-notes, to give a little graceful whine at the end of a phrase, just as the modern player sometimes whines, for expression, upon his violin. It rests upon the best authority that the quarter-tones were not an essential part of the scale, and that they were not sung originally. Plutarch states that ancient singers, and singers in the ancient manner, did not employ them; and when Aristotle says, as in his fifteenth problem of Section 19, that enharmonic melodies were preferred to diatonic, on account of their ease and simplicity, so long as it was the custom for gentlemen to sing in the dithyrambic choruses, it may be taken for certain that the gentlemen did not attempt to sing quarter-tones in chorus. The gentlemen's reason for preferring the enharmonic was a valid one. The ascending Fourth and the minor Seventh are not easy to sing by ear without accompaniment, because they come from different roots to that of the key-note, and want the support of a different base. The reader will find this fully explained in the chapter on the basis of the science. The minor Seventh is rejected, and the major Seventh, only half a tone below the octave, is substituted for it in our present minor scales because the former is so unsatisfactory to the ear.

The Greek chromatic scale was a great improvement upon the Greek enharmonic. It includes the enharmonic minor scale of the A, B, C, E, F, A, but it changes the two quarter-tones into F sharp and C sharp.

By these sharps, when used instead of the corresponding naturals, it adds a major scale of the same number of notes as the minor; each wanting the Fourth and the Seventh. This kind of major has been popularly called the Scotch scale, and it has been recently named *pentatonic*, or "five-toned." The last is not a happy designation, because it consists, not of tones only, but of tones and minor Thirds. If the name must be Greek, *pentaphōnic* would be a less equivocal compound. The minor Thirds are caused by the omission of the two semitones of the scale. Supposing it on the white keys of the pianoforte, the notes would be C, D, E, G, A, C, omitting F and B. If transposed to the black keys of the pianoforte, it would be in regular ascending order from F sharp. I offer explanations in this digested form in order to bring the points more vividly before the mind of the reader. The mere recapitulation of the notes, or intervals, would make but little impression on the memory; but by the system of explanation which I make a rule to employ, we see at a glance the use of the scales, and we appreciate the ears of the Egyptians and of the Greeks. It is remarkable that, out of the three specimens of Greek music, which the readers will find here given in a more intelligible form than by Dr. Burney, one hymn should be in a major key, although the Greek diatonic system hardly admits of such a scale. It could only be by change of key in a piece of music, thus making a second key-note, or *Mese*, on the third note of the scale. Yet how

natural it is, having A, B, C, D, E, F, G, as a scale, to begin sometimes on the third note, C, and thus to change a minor into a major key. The ear guided to it, against the laws of the time.

And now to a point which more immediately concerns the reader of classics than the musician, and which, being now developed through music, may deserve a little further consideration from the lexicographer. The misapplication of Greek words by the Romans was by no means limited to musical terms; it extended into various arts and sciences, and it has affected the translations made within the last three or four centuries from Greek authors. One extract from Vitruvius (here quoted in a note at p. 380) will suffice to establish the case as to the admitted corruption of terms in architecture; but, I submit, a very simple and general example of a perverted meaning in the Greek preposition *anti*. When *anti* is compounded into newly invented English words, it is invariably in the Roman sense of "against;" while in translations from the Greek, where "against" would contradict the sense of the author—as in all references to a future time—it is commonly rendered by the Latin "*loco*," or "in the place of." If a thing be "against" another, it cannot be "in its place;" therefore one of these two must be incorrect, or, at best, but a secondary sense, due to the word with which *anti* is then compounded. But there is a third translation, which should be brought more strongly than hitherto into notice, and one too firmly supported by the highest Greek authorities to

be at all doubtful. It will be seen by them that *anti* means "accompanying," "corresponding," and "in harmony with." Therefore, far from being "against," it is in perfect concord and agreement with its fellow; and it is certainly not "instead," or "in the place of" anything, because the simultaneousness of the two is often necessary to constitute the harmony.

Meibomius, in the preface to his translation of the Greek authors upon music, admits this to be one sense;[a] but still he prefers *pro*, "for," which is perhaps doubtful, as well as "against," as *primary* senses, for the following reasons. The four letters, *anti*, cannot have three meanings so opposed to one another; and, consequently, two of the three, if correct, must depend upon their compounds. I submit that the primary sense, which yields all the three in composition, is nearly expressed by our word *counter*, as compounded in *counterpart*,—not being necessarily "opposed to," but more frequently "like," or "corresponding with." Perhaps we have no exact word to express *anti* fully in the English language, as it means both "accompanying" and "corresponding with;" "the fellow," or "the other." "Counter" seems to be the nearest. In the excellent lexicon of Liddell and Scott these appear as sixth and seventh meanings to *anti*, but only in composition.

[a] Quam enim falsa est vocis ἀντίχορδος interpretatio; "*contrarias* chordas habens, *contrarium* sonum chordis emittens, *obsonus, dissonus*" (quam etiam in *Thesaurum* suum transcripsit Stephanus), cum explicandum sit "*consonus, conveniens, concordans, congruens*," ut Hesychius et Suidas illam optime explicarunt, &c.

Two "fellows" may accompany one another in concord; but they may also be hostile, and then are "against" one another. Or, one may follow and take the place of the other, and thus become, in a secondary sense, his substitute, or "instead of" him. The Romans employed *anti* in the sense of "against," sometimes with an admission that their use varied from that of the Greeks.[a] It is only through the Latin that we derive such corrupt meanings of Greek words, as in "antiphonary," "antiphonal" singing, as well as many more which will be shown in this history, more especially when it descends to the mediæval period, to have hardly any relation to the Greek sense. Upon the point of antiphonary and antiphonal singing, full authorities are given here at p. 11, beginning with Plato and Aristotle, down to Byzantine Greek. These all agree as to the consonant and corresponding sense of *anti*, which, therefore, seems to deserve greater prominence than it has yet received. If we take such a compound as *antibasis*, it is a "fellow or companion" base of a second column,[b] neither opposed to, nor as a substitute for the first. But the real test of the meaning of the word is where *anti* stands alone; and, without having travelled out of my path to seek for examples, there are two in the following pages, in which *anti* can neither mean

[a] Interdum enim substituitur mutua accusatio, quam Græci ἀντικατηγορίαν vocant, nostrorum vero *concertativam*.—(Quintilian vii., cap. 2, 9.) In quibus similis, atque in ἀντικατηγορία, personarum, causarum, ceterorum *comparatio* est: ut Cicero, pro Vareno in familiam Anchiraniam.—(*Ibid*, 10.)

[b] Columellæ basis in solo foraminum octo. . . . Posterior minor columna, quæ Græce dicitur ἀντίβασις.—(Vitruvius, lib. x., cap. 10, *vulgo* 15.)

"against" nor "in the place of." In both of these cases the translators have rendered *anti* by "in the place of" *(loco)*, and they thus reverse the meaning of the authors. The first quotation is at p. 53 of the following, where the reputed Demetrius Phalereus, but rather Dionysius of Halicarnassus, recommends the use of a musical instrument to accompany the voice, in order to keep it in tune, and the translators have changed it into advice to sing *without* an accompaniment by their "in the place of" instead of "with the accompaniment of." In the second instance, p. 305, the translator has been driven to a perversion of the words of Sophocles, of which he must have been fully conscious (translating *ὡσπερεὶ λύρας* as if Sophocles had written *ὅς περί λύρας*), in order to create a justification for his rendering of *anti* by *loco.* The Greek original is by Polydeuces, who was appointed to the Chair of Rhetoric at Athens by the Roman Emperor Commodus. He is now more generally known, under the romanized form of his name, as Julius Pollux.

In reference to this second example, it is to be remembered that, according to authorities, there were but two horns, usually goats' horns, to a lyre, and that they were on opposite sides. The only further use of horn in a lyre seems to have been for the pegs, which, having been originally made from the thick skin of the neck of an ox, retained the name of *kollopes,* as well as of *kollaboi.* All sculptures and paintings agree as to two horns only, as do authors, so far as I can trace them, who make

specific mention of the parts of the lyre.[a] Such a material as horn would have been unsuitable for the lower bar, or hypolyrion, of the lyre, to which the strings were attached in primitive instruments; for, even if straight, a natural horn would taper in circumference, and if a large piece of horn were pared down to a suitable size and length, it would be unfit for the purpose, owing to its elasticity. The drawing up of one string would disarrange the rest. Upon these grounds I am of opinion that there was not any third horn on the lyre.

As to *anti* in the sense of "against" and "opposite to," there is sufficient reason for rejecting both as not being primary translations, because they are demonstrably incorrect when the Greek word is used in reference to a future time. For instance, when Archelaus reigned in Judea, "in the room of his father Herod" (*ἀντὶ Ἡρώδου τοῦ πατρὸς αὐτοῦ* —Matthew ii. 22), Archelaus could neither be "against" nor "opposite to" his father, because he ruled only after Herod was dead. Perhaps our translators might have been justified in translating that Archelaus reigned "correspondingly to," or "like" his father Herod, since we admit the rendering of *anti* by "like" in the compound word, *antitheos*, "godlike," in the works of Homer, of Plutarch, and elsewhere. These, however, are questions which must be left wholly to the judgment and to the decision of our eminent and matured Greek scholars.

[a] Τῆς λύρας τὸ σόφισμα πρῶτος Ἑρμῆς πήξασθαι λέγεται κεράτοιν δυοῖν καὶ ζυγοῦ καὶ χέλυος . . . τὸ μὲν γὰρ κέρας αἰγὸς ἰξάλου, ποιηταί φασι. —(Philostrati *Imagines*, i. 10; Amphion.)

It is still right that I should draw attention to any points which the investigation of Greek musical terms may suggest, and it appears to me that musical evidence runs in this direction; unquestionably it is so in musical compounds. There is still some amusement in store for Greek scholars with the preposition *anti.*

In the chapter on ancient musical science, and upon those immutable laws which should form the basis of all musical science, whether ancient or modern (pp. 186 to 251), I have endeavoured to explain the laws of nature as to sounds in a more generally intelligible manner than they have, perhaps, been hitherto presented. This is by reverting to the teaching of the string and of the pipe, from which those laws were first learnt. Nothing can be more simple, and I take it to be a great desideratum in writers of history that they should make themselves understood by the largest number of readers.

Some misconceptions of the science are really curious, and I can but think that even the laws which determine musical sounds are not well understood, if we may take some of the most popular works of the day as examples. I would instance *Die Lehre von den Tonempfindungen als physiologische Grundlage für die Theorie der Musik,* by H. Helmholtz, Professor of Physiology in the University of Heidelberg. This work has been widely popularized through a series of lectures delivered at the Royal Institution of Great Britain, and subsequently in other parts, by the Professor of Natural Philosophy in that

institution. The third edition of Helmholtz's work bears the date of 1870, and the second edition of the Eight Lectures on Sound by Professor Tyndall, of 1869. The lectures are largely derived from Helmholtz, but still they include some antidotes to his doctrines.

I cannot admit that Helmholtz's deductions from the *Tonempfindungen* are such as will lay a true "physiological groundwork for the theory of music," as designed by the learned author. Not only are there reasons for differing with him as to the due employment of the scale of natural sounds, but also as to his theory of harmonics; as to his supposed causes of consonance and dissonance; as to his imaginary causes of difference in the tone of musical instruments; and as to the true nature of "resultant tones," to which he has assigned the new name of "difference tones." I might add to this list of objections; but, since physiology is defined as "the doctrine of the constitution of the laws of nature," such examples as the above are essentially within it, and may suffice.

If Professor Helmholtz had duly appreciated the use of the scale of natural sounds or harmonics to which he assigns the name of "overtones"—and I demur, contending that they are not *over*, but simply a scale of successively rising sounds—he would have taken the primary note of the whole string for his No. 1, just as Dr. Pole has done in his Tables of the natural harmonic notes, incorporated in the *Treatise on Harmony* by the Rev. Sir F. A.

Gore Ouseley, Bart. The reason for preferring it so is obvious. No. 1 is the sound of the whole string; No. 2, when it divides itself into two halves, each half simultaneously sounding the Octave above No. 1. No. 3 is when it divides itself into three parts, each of the three sounding the Twelfth (a Fifth added on to the Octave) above the fundamental note. *Mem.*, that the third part of the whole string is identical with two-thirds of the half string, therefore they yield the same note, viz., a Twelfth above that of the whole length.

In order to avoid explanations embarrassing to the reader by simultaneous calculations of the rising Octaves in the Harmonic Scale, I have explained all the sounds as they lie within one Octave of the whole string. Therefore I say, "*Stop* the half string, and you *raise the pitch of the remainder* by an Octave. Stop the third part of a string, and you raise the pitch by the interval called a Fifth. Stop the quarter of a string, and you raise the pitch by the interval of a Fourth. Stop the fifth part of a string, and you raise it by a major Third. Stop the sixth part, and you raise it by a minor Third. Stop the seventh part, and you raise the pitch by something less than a minor Third, it being the proportion of 7 to 6, and the exact interval which divides the Fifth of the Scale from the Harmonic Seventh. Stop the eighth part of a string, and you raise it by the still smaller interval between the Harmonic, or true, Seventh and the Octave.

These seventh and eighth sounds are not used by

us in music, but they are Nature's primary divisions of the interval of the Fourth, as between G and C, in the key of C. Nature has the same number of divisions for that Fourth as for the Fifth below it, viz., C to G, but we lack words to express the two sounds which divide the interval of the Fourth, because, having already a minor Third, we have but a "minimum" Third to give to each of them, unless technical use will permit us to name the former a diminished minor Third, and the latter the minimum minor Third.

If we pursue the division further, stop the ninth part of a string to raise it by a major tone, and stop a tenth part to raise it by a minor tone. So just as the string divides itself in nature (exemplified in the Æolian harp), or is divided by art into a smaller number of aliquot parts, the musical intervals diminish and the pitch rises.

But Professor Helmholtz holds a theory that, when a string is struck, all these harmonics are simultaneously superposed (see Helmholtz, pp. 262-3, and Tyndall's Lectures on Sound, pp. 116 and 127.) How is it possible that a string can divide itself by nodes into all these sounds simultaneously? If this theory be true, there can be no such thing as concord in music. We might as well play with our elbows upon the pianoforte, and sound an Octave of notes, or more, at once, as lay the finger upon a particular key. This singular conclusion seems to have been arrived at through the use of a Resonator; forgetting that—like a shell held to the ear—it might be

producing, instead of repeating, a sound: or else, by mistaking reverberation for the simultaneous emission of many notes from one string. The changes are certainly rapid after the primary sound. I have listened to them, perhaps a thousand times, in years gone by, to try to follow the scale as I heard it rising, and to test the judgment of my ear by trying to touch the final note upon the pianoforte. There were many sharers with me in those experiments. Some of the old grand pianofortes yielded harmonics very freely. I appeal to any practical musician, but especially to those accustomed to pianofortes; also to pianoforte manufacturers and all tuners, whether it is not indisputable that harmonics succeed one another. Surely it is Helmholtz's error in this respect which has led him into numerous others. If the reader should still have any doubt, let him turn to Regnault's Experiments upon sound conveyed through gas pipes at Ivry, printed in the appendix to Professor Tyndall's Lectures (p. 329, edit. 1869). I quote a few words. "In very long conduits, to hear well it is necessary to employ a baritone" (voice); "the fundamental sounds are heard before the harmonics, which then succeed each other in the order of pitch." If more evidence be required, turn to Professor Tyndall's Fifth Lecture (pp. 202-3) for an account of Kundt's experiments. He strewed the light dust of lycopodium within a glass tube, and the formation of the nodes could be seen, and how they were all changed with any change of note. It is, of course, impossible that a column of air within a pipe can

divide itself simultaneously into four, five, and six parts, because the nodes of the four must interfere with those of the five, and those of the five will be altogether different from those of the six. It is precisely as impossible in a string. The little paper jockeys that are saddled by experimentalists upon the nodes of a string are thrown off the moment the note is changed, and they prove that the nodes no longer exist in the same places. These nodes are the junction points of uniform vibrations which act in opposite directions. Each node is kept at rest by the equality of tension in those opposite directions.

Next, Professor Helmholtz asserts that "it is the addition of such overtones" (which I call harmonics) "to fundamental tones of the same pitch, which enables us to distinguish the sound of a clarionet from that of a flute, and the sound of a violin from both." (Tyndall, p. 127.) This is, indeed, a strange theory. It falls to the ground at once by the fact that the harmonics of the flute and of the violin are the same! How would the learned Professor account for the great differences of tone produced in harmoniums of many stops? He cannot, surely, be aware that the springs of harmoniums emit no harmonics, but only Resultant Tones when certain two notes are sounded together. Helmholtz has written upon harmonics without having studied them sufficiently, for he cannot even know that, if there are three organ pipes, one triangular, one square, and the third a parallelogram of two to one in breadth of sides to breadth of ends,

they will produce different qualities of tone, and yet all have the same harmonics.

Next, as to consonance and dissonance. Surely the meaning of those two words is sufficiently expressed in their names, derived from *consono* and *dissono,* and yet Helmholtz misunderstands them. I have fully explained them at p. 221, and the theory of Helmholtz follows, at p. 225. After my sheet had been sent to the printer, I observed that an explanation, anticipating mine, had been more concisely expressed by Sir John Herschel, in a quotation given by Mr. J. H. Griesbach. I have re-quoted Sir John, through Mr. Griesbach, at p. 237, but should have covered myself with Sir John Herschel's ægis, if I had noticed the passage in sufficient time.

Next, as to Resultant Tones. The unsoundness of Helmholtz's theory is, I think, sufficiently shown at my pp. 247-8. In his change of the name of Resultant Tones to Difference Tones he was misled by his imperfect experiments. He employed the Syren, a nondescript instrument, through which numerous puffs of air are simultaneously emitted, one puff through each hole. He forgot that each puff then becomes a separate column of air, and, therefore, a separate instrument. Although he heard the one sound neutralizing the other, thus causing intervals of silence, he did not allow himself time to think. This was the case of the two tuning-forks over again, as illustrated at p. 258 of Tyndall's lectures. The condensations of the waves of sound issued by the one coincided with the rare-

factions of the other; therefore, while the one urged the particles of air forward, the other drove them backward, and, the two having equal forces, each neutralized the other. The experiment to prove this may be put in practice by any one, as it was by me repeatedly in days long ago. Take two tuning-forks of equal size and perfect tune together; set them into vibration; hold one at an angle to the ear, and turn the other slowly round close to it; sometimes each will diminish the tone of the other, and, if held equidistant and the two forks are exactly equal, they should neutralize one another. You may perhaps require a looking-glass to hold the two exactly equidistant, but another person can hold them. Partial neutralization is easily attained, but complete neutralization is hardly practicable in this rough experiment, from the time lost in finding the requisite distance, and the short duration of the vibrations. The two forks must not be struck together, because it is necessary that the one shall begin on the half vibration of the other, in order to neutralize its sound.

I am persuaded that the *Tonempfindungen* is a hasty book, written under the pressure of manifold engagements, and that the amount of fame and popularity which has attended its production was not fully anticipated. Therefore the value of time was too largely considered in its composition, and some very necessary experiments, such as those upon harmonics, were omitted. But, since success has been so widely attained, it may be hoped that

the author will find time to revise the next edition of his popular book, and, in doing so, that he will bear in mind an admirable motto for men of science, *Chi va sano, va piano.*

I will note one more error, not only because an important one, but because in it Professor Helmholtz stands by no means alone. It seems to me the invariable practice of mathematicians who write upon musical scales, to mark the Fourth above the key-note as in the proportion of 4 to 3, and the Sixth as in the proportion of 5 to 3. Thus they ascribe concordant proportions to two discords.

When a string divides itself successively into three, four, and five equal parts, making three, four, and five vibrations in the same time as one vibration of the whole length, the notes produced are the Twelfth (or Octave and Fifth) which arises from the three parts—the Fifteenth (a double Octave) from the four parts—and the Seventeenth (a Major Third above the Double Octave) from the five parts. This may be verified by any one who will refer to the scale at p. 217 of this book; but it may also be satisfactorily proved to the ear in a moment. Suppose the scale to be that of C: the F above C is still marked as 4 to 3—*i.e.*, as 4 vibrations of F to 3 of C—and A, the sixth above C, as 5 to 3. This will only be true if you play F as the base, for F is the required Twelfth below C, and the two concords belong only to the key of F. If we take such a base as C, one or two octaves below the nominal key-note, our string is too long or too short,

and we change our concords into discords. The only true 4 to 3 and 5 to 3 in the key of C, are the Fourth of C down to G; and the Sixth of E down to G.

The reason of the misapprehension of old mathematicians is that they knew not the Harmonic Scale. They calculated intervals, but did not limit them to their proper places. The order of a scale may not be changed. Although called Octave Scales, ours are not really so. Each has two roots, derived from two Greek Tetrachords or Fourths, which I show to have been borrowed from Egypt. We owe more to those old gentlemen of the Pyramids than has been hitherto suspected.

In the exceedingly wide range of subjects which a history of music entails, I have often desired to consult others, especially to hear objections to any conclusions I might be inclined to draw, and sometimes to avail myself of the sanction of great names as authorities. To these gentlemen acknowledgments are usually made *in situ*, but there are other obligations which have not been expressed. Some authors have a preference, in which I largely participate, of having their errors pointed out before, rather than after, their books have appeared in print. I confess to a particular objection against having too often to sing *Plaustrum perculi.*[a] My own proofs would have been indifferently corrected if wholly by myself, for I can hardly read them critically, knowing what was intended, and often overlooking typographical errors from worn sight.

[a] "I have upset my apple-cart—I am done for!"

I had also a dread of tripping in my translations from the Greek, since my antiquated studies ended in the year 1823, but I have had the kind assistance of a very learned friend, Mr. W. Aldis Wright, M.A., Bursar of Trinity College, Cambridge. He most obligingly looked over the proofs of the first eight chapters, which contain most of the hard Greek passages; and kindly contributed the note on p. 30, which bears his initials; he also examined my translation of Herōn's Hydraulic Organ. Lastly, I am indebted to the Rev. J. P. Mahaffy, F.T.C.D., and Lecturer on Ancient History in the University of Dublin, for having carefully revised the proofs, after all sheets except the last had been printed off. To Mr. Mahaffy I am further indebted for the use of the Egyptian caricature which appears at my p. 399, and which forms the frontispiece to his *Prolegomena to Ancient History*, 8vo. 1871.

This calls to mind my very great obligations to Mr. Murray for casts from the woodcuts in Sir Gardner Wilkinson's works on Ancient Egypt. It would have been scarcely possible for me to have given an adequate representation of the musical instruments of ancient Egypt, without recourse to Sir Gardner Wilkinson's works, for they contain more examples than all the other splendid publications upon Egypt together. Nevertheless, I have sometimes drawn from other sources, and am indebted to Lepsius's Denkmäler for establishing the certain practice of harmony among the ancient Egyptians. When three pipers are

playing together with pipes of different lengths, we can almost establish the notes which they are playing.

I have had the advantage of consulting other learned friends upon special subjects; among them I may gratefully mention Dr. Ginsburg, Professor T. Chenery, Dr. Samuel Birch, LL.D., Sir Charles Wheatstone, F.R.S., Dr. Pole, F.R.S., and Mr. J. H. Griesbach, besides, in numberless cases, my old friend Mr. G. A. Macfarren, Professor of Harmony at the R. A. M. His criticisms have been of great value, and have often led me into new trains of thought; for he is unquestionably one of the most scientific of eminent musicians in Europe. Still, no one of my more learned friends is to be held responsible for any opinions that I may have expressed. I can only plead endeavours on my part to arrive at truth, and that I had no pre-conceived theory to support, which might have had the effect of warping the judgment. As to whether I have added any original remarks which may be of value, I really cannot tell, not having read the works of modern writers sufficiently. Too often have I been reminded of the truth that "nullum est jam dictum quod non sit dictum prius," by finding that what I supposed to be my own had been anticipated by others. Therefore, I find it safer to make no claim. It is all the more probable that I may have been anticipated, because I have started without any crotchets. Still, I hope that the book may be found a useful sifting of true from false doctrine.

I have been induced to write this long introduction by the recommendation of a friend. It is to give an epitome of some main points of the book for those who may feel interest only in one of the numerous subjects, and who may not care to enter upon all. Space can be given to it for the following reason. My intention was to have included Hebrew Music, and to have made a thicker volume. While labouring at that subject, and when, through not understanding the Hebrew language, I could not advance further than the Septuagint, with Philo Judæus and Josephus, who wrote in Greek, adding to these a few extracts from Greek authors, my learned friend, Dr. Ginsburg took pity on my case, and offered to undertake that part of the history. I was exceedingly glad of such an offer, for everything relating, even indirectly, to the Bible, ought to be done in the best possible way. But the subject grew in his hands to such an extent as to exceed the limits of the proposed volume. This was discovered only after many sheets had been printed off. I then added one more sheet to my own work, which therefore appears with starred pages, and Dr. Ginsburg's History of Hebrew Music will form a second volume.

The recommendation to me, to make an attempt to explain Greek music, proceeded many years ago from the late eminent historian, George Grote, at one of many intellectual gatherings at his house, first in Eccleston Street, and afterwards in Savile Row. It was no doubt owing to my having shown

a disposition for any work which would advance the cause of music. Between 1838 and 1840, in addition to every day duties, I had collected and published, in two quarto volumes, the National English Airs with their history, and had projected and taken an active part in carrying out two societies —the Percy, for the publication of old ballads, lyric poetry, and such prose as would exemplify the manners and customs of our forefathers; and the Musical Antiquarian Society, for the publication of early English music. The two societies flourished together for eleven years, and did good service in their time. The latter brought around me many eminent musicians, from whose discussions I could but profit, and thus improved my small acquaintance with the principles of the art and of the science. The like advantages of association with first-rate musicians subsequently enabled my youngest brother to direct the Monday Popular Concerts, and to bring forward many unknown musical gems of the highest order for the patrons of those concerts. Thus, he has now been working for many years at one end of the chain, to advance the knowledge and to improve the cultivation of music, while I have still laboured on at the other, to establish the basis, and to unite the scientific with the practical knowledge of the art. I hope to have presented the science in so simple a form that no one who intends to be a musician will think it too much to digest. How greatly a little science will help will be seen in many parts of this little volume.

Mr. Grote's enthusiasm for the Greeks somewhat exceeded mine; and, although my recollection of the language was fresher than now, I did not suppose that, even if I should succeed, a knowledge of Greek art and science would greatly advance those of the moderns; therefore, I received the proposal rather lukewarmly. But when favoured with the twelfth and last volume of the History of Greece, with an inscription from the illustrious author, in deference to his long-antecedent recommendation, I took the first step forward, by buying the works of the Greek writers upon music. Still, it appeared to me that the Greeks could wait until I might be able to devote uninterrupted attention to them; and thus years passed on.

It was therefore not improbable that my attempts upon Greek music might have been deferred to the Greek Kalends, but for an accident of comparatively recent date, in consequence of attempting too youthful a jump with gun in hand. This confined me to the house, gave me more time for reading, and the books were then taken from the shelves.

In the intervening years I had so enlarged the collection of National English Airs, and had so many anecdotes to add in illustration of them, that I re-wrote the entire work, arranged the airs in chronological order, and changed the title to Popular Music of the Olden Time. I had also assisted M. de Coussemaker in his *Scriptores de Musica veterum, nova series*, so far as having prepared for publication some dozen of mediæval manuscripts, copied from the British

Museum or the Bodleian Library. Having retired from publishing music in 1861, I had time to give to an enthusiastic correspondent who would undertake so desirable, though pecuniarily unprofitable, an enterprise. M. de Coussemaker's predecessor, the Abbé Gerbert, had not examined the libraries of England.

While thus engaged I had taken note of the odd uses of Greek words in manuscripts of the Middle Ages written in Latin. Therefore, while reading the Greek authors on music, I continued to copy out such definitions of musical terms as I then encountered. I began without expectation of success as to understanding the music of the Greeks, owing to the number of abler men whom it had baffled; but I thought the definitions might be useful for a glossary of musical terms projected by my friend Dr. Rimbault. My little glossary seemed, however, to afford the clue, and soon made me interested in the subject. It became evident that the Roman perversion of Greek musical terms had been one of the great difficulties in the way of previous enquirers (although by no means the only one), for I could then understand the system. Eventually, I found that the theoretical and practical system of the Greeks had been borrowed entire from Egypt or from Asia.

Music and Astronomy were so intimately mixed together by the ancients, that some of the most decisive passages about music were gathered from descriptions of the planetary system, in reference to the supposed harmony of the spheres.

Astronomy was included in the ancient definition of music, which comprised all arts and sciences over which the Muses were supposed to preside. Whether the result of an Egyptian origin for Greek music would have gratified my late friend, I cannot tell; but I have one great regret—that I did not commence the enquiry a year or two earlier, so as to have published this volume during the life of the illustrious historian by whom it was suggested so many years ago. It would have gratified me to have presented him with the solution of the riddle, in memory of earlier days.

Music has a just claim to rank highest among the arts. It held that position undisputed for many ages in all civilized countries. The over-zeal of would-be-reformers in the sixteenth and seventeenth centuries —a zeal which culminated in the destruction of all cathedral organs by the mob during the Commonwealth—threw the first cloud over the cultivation of music in England.

In the desire for radical change, some of the zealots objected to alternate, or "antiphonal," singing, wherein the psalms are chanted by one half of the choir in response to the other, each taking up alternate verses.

Ignoring church history, they did not care to know that this was an ancient Jewish way of chanting the Psalms of David, or that it had been introduced into the Christian Church in the fourth century, and with such unequivocal approval on all sides that it spread immediately from the eastern to the western

branch. The Puritans termed it "tossing and bandying about the Psalms from one side to the other like tennis balls." To them it signified not that the very meaning of "Psalm" is "to be sung with the accompaniment of a musical instrument," and that no words can constitute a Psalm if unsung. They would have the words read, without music; but yet they inconsistently "bandied them about" between the minister and the people. A Babel-like confusion of tongues then took the place of the orderly, time-keeping chant, and each man strove to make his own voice distinguishable by its difference of pitch and pace, one at the most rapid rate of utterance, another at the most lengthened-out drawl.

The Puritans strenuously objected to all music: they complained that it was the companion of mirth and frivolity, and that it incited to dancing and sports, all which they desired unequivocally to put down. The world ought, in their judgment, only to be sorrowful and full of lamentations—not even expressing thankfulness for mercies. In the words of Prynne, one of their sect, the people should be "not dancers, but mourners, whose tune is *Lachrymæ;* whose music is sighs for sin; who know no other *Cinque-pace* but this to heaven—to go mourning all day long for their iniquities; to mourn in secret like doves, to chatter like cranes for their own and others' sins." Some may think that "others" should take care of themselves; and it might be questioned whether life would be desirable if such were to be its one melancholy employment.

The cloud which these men left upon music is even now but slowly and gradually passing away. It is to be hoped that, when removed from one side of the intellect, it may not stop to settle down upon any other.

Music is incomparably the most original of arts: it is the pure creation of human intellect. Music is the perfection of an art, for it has no evil tendency. Music has a far greater and more immediate influence upon the mind than any other art. And yet, since the melancholy advent of puritan gloom over England, the cultivation of the eye has far exceeded that of the more delicate organ, the ear. What other art than music can claim to induce cheerfulness, to soothe alike the excited, the overburdened, and the overworked mind; and to have the power of raising the spirits so far as even to warlike emotion? While imitation enters largely into all those which are colloquially termed Fine Arts, and a perfect representation of Nature in her best moods is a great perfection in a painting, imitation of Nature is hardly admissible in music. It is but as an accessory in descriptive pieces that it is in any way permissible.

To bring up a child from infancy to hear and to cultivate music is to add a new pleasure to its life. The taste is one which never dies away. Indeed, music may be cultivated to any extent, and afford new pleasures at every stage of cultivation. Beginning with the simplest sounds, one at a time, the ear is gradually led on to the appreciation of many simultaneous movements in the most delicate and

even intricate combinations of sound. The infant is perhaps invariably susceptible to the powers of music, but this gift of Nature is too often put aside and neglected until susceptibility is so much diminished that complaints are made of bad ears for music. These bad ears are generally recoverable, if the neglect has not been too long continued. Upon this point I can speak with certain knowledge. But there are cases in which, through long neglect, susceptibility does pass away, and then, in after life, music becomes tantalizing, or even irksome. Such men are to be pitied. Too often their dispositions become morose, or we read of shattered nerves unable to bear music, to which it ought to have been the greatest comfort; perhaps, also, of a statistical increase of insanity. It did increase largely in the days of the first descendants of the Puritans, for whose special requirements New Bethlem or Bedlam was built. Music is now found to be so great a solace to the insane, as to be almost universally adopted in their treatment. Let the irritable man console himself with music, as did Achilles with his lyre.

Many persons now wonder at the enthusiastic love of music of the simpler kind expressed by Shakespeare; but they will find like expressions of admiration in other great writers, both of his time and before it. These men cannot all have combined to deceive their own age or that of the moderns. There must be truth in it. Susceptibility is now less only because cultivation is diminished, and too

long delayed. The most brilliant examples of development are among those who heard music from the cradle. Haydn, Mozart, and Beethoven, were all sons of musicians—the first of an organist, the second of a violin teacher and composer, the third of a tenor singer.

The consent of ancient nations in favour of music is so universal that it would be but a question of time to collect a thousand proofs. I will cite one passage from Plutarch's *De Animæ Procreatione*, because it bears upon a supposed difficulty. In ancient sculptures and painting we see representations of musical instruments, such as heavily ornamented lyres, with only four or five strings, and other fanciful instruments, which, for musical purposes, would have been useless. These are usually found in the hands of gods and goddesses; and the painter or sculptor has indulged his fancy as to their forms and frames, because he intended them only as *emblems*. Thus Plutarch says:—"Theologians of early times, the most ancient of philosophers, represented the gods as holding musical instruments in their hands, not indeed because they supposed them to play the lyre or the pipe, but because they judged no work more appropriate to a god than harmony and music."

The first step to the advance of music in England should be the repeal of that unwise Act of Parliament, 25th of George the Second, which made a license necessary for the public performance of music. Under the plea of preventing thefts and robberies,

every room or garden "kept for dancing, musick, or other publick entertainment of the *like* kind, must be licensed." Why should men be restrained from singing anything that they are permitted to speak? Other countries do not find such precaution necessary. The people require social gatherings, and cannot always go to a distant licensed house, and pay for admission. They should be allowed to have their fiddler again, and to pay him as they did. The effect of the Act has been only to engender a race of public-house politicians, who persuade themselves that they alone are fitted to govern the country, so that every spouting demagogue can now draw a train of excitable followers, rather anxious for a grievance, and boding disturbance to the State. The Government which would bring about the repeal of that Act would deserve well of the country. If music had the faculty of engendering demagogues, there would have been a storm about it long ago.

If one would further stimulate ministers to be a little less shabby in their treatment of the Royal Academy of Music—which, with proper assistance, would be a far more useful institution than the Royal Academy of Arts—he would deserve the hearty acknowledgments of all lovers of music, both now and hereafter. Only a few can buy a picture, but all may have a Beethoven at home for a shilling. A paltry £500 a year to so useful an institution as the Royal Academy of Music is a stigma and a disgrace to England. A single church, such as St.

Andrews, Wells Street, spends at least double that amount upon its music. Indeed, the art deserves altogether more consideration than it now receives.

Time still wears on, and although the author of *Maritana* sings "Turn on, old Time!" such is rather the desire of the young than of those who begin to feel his advances. In order to provide that no one of my friends or patrons shall incur the risk of having an unfinished work, each volume of this history will embrace a period complete in itself, and have its index. Although I have reasonable expectation of carrying it to the end, the production of the whole promises occupation for several years. The music of the Middle Ages will form my next subject, and it is one for which preparations have already been made. It has hitherto rivalled Greek music in obscurity, and the present accounts abound in errors.

My friend Dr. Rimbault proposes to write a new history of modern music, uniformly as to size with mine, and commencing where I may leave off. He will exhibit, by extracts, the progress of modern harmony, which will be a boon to the musical world, and it is one which only a musician, and one who possesses, or has access to, a very large library of early authors can carry out.

WM. CHAPPELL.

1*st June*, 1874.

Strafford Lodge, Oatlands Park, Surrey;
or, to the care of my Son,
E. Chappell, at 50, New Bond Street, London.

GLOSSARIAL AND EXPLANATORY INDEX.

(*Greek and Latin words in italics, and y grec for Greek v.*)

EXPLANATION OF THE WOODCUTS AND OTHER ILLUSTRATIONS.

THE HISTORY OF MUSIC.

CHAPTER I.

The first firm footing for history.—The new field opened by recent discoveries.—Why Greek music has been found a difficult subject.—The Romans adopted but one portion of it in its oldest form.—The latest Roman writers.—The Mediæval system.—Examples of misapplied Greek terms.—Greek love of Octave harmony.—Church Tones not Greek music.—New difficulties prepared for German readers.—No evidence of any ancient Standard Pitch.—The Greek system of music both intelligible and explicable.

The most convenient basis for a history of ancient music seems to be the early Greek system, for we are here removed from the land of myths, and have the foundation upon which the superstructure of modern art has been raised. The discoveries that have been made in Egypt and in Babylon, within the century that has now passed, since Sir John Hawkins and Dr. Burney wrote their Histories of Music, have revealed an advanced state of the art in most ancient times, which was before unknown and unsuspected. There is no longer room to doubt that the entire Greek system was mainly derived from Egypt, Phœnicia, Babylon, or other countries of more ancient civilization than Greece. The musical

instruments of the Greeks may be traced in Egypt, even to the hitherto unobserved *Magadis*, or Octave playing instrument, of Anacreon, and to the little wailing "span-long" pipe used for lamentations on the death of Adonis. From that pipe must the modern hautboy claim its descent. The total number of notes in the combined Greek scales agrees precisely with the enumeration of the Egyptian system, as revealed to us by Greek writers. The worship of Athena, or Minerva, who corresponds to the Egyptian goddess Nēth, was attended by the peculiar custom of having musical instruments to play in Octaves in the temples of both countries. The same system of music must have prevailed in the two, because they had, at least in one case, the same song, and it was a song that, according to Herodotus, was in general use.

Moreover, a further discovery may be noted through Egyptian monuments, that, at the time of the building of the Pyramids, and before the invasion of the Hyksos, or Shepherd Kings, had made "every shepherd an abomination to the Egyptians," those Egyptians had bands that played with harps and pipes in concert—not in unison, as might have been supposed, but in harmony. This is made manifest by at least one of the representations on the tombs of the fourth dynasty of Egypt. Three pipers have a conductor beating time for them, and their pipes are of such different lengths, that it is mathematically impossible they could have been playing in unison. Further, it may be proved to demonstration, that the ordinary Egyptian lute had then a compass of two Octaves. The hieroglyphic for "good" makes this evident. It is a lute with

a neck, which is from two to three times the length of the body. Again, this lute being provided with not less than two strings, shows a provision for playing double notes (to make harmony), because one string having a compass of two Octaves, would have been all-sufficient for melody. A single string, with a neck against which it may be pressed, makes a scale for itself.

Another point worthy of observation is the practical agreement and general identity between the musical instruments of Egypt and those of Nineveh and of Babylon. This is largely exhibited in ancient sculptures, and may be observed by any visitor to the British Museum. If we couple with this resemblance the incidental notice of the Chaldæan division of the Octave, by Plutarch, and that of the reputed *Diatessarōn,* or musical interval of a Fourth, in the Babylonian planetary system, by Dion Cassius, they should suffice to establish the identity of the musical systems of Assyria and Egypt.

When examined by this new light, the musical acquirements of the Greeks will appear but as one branch of the transfer of learning from Asia to Europe; for the Egyptians were admittedly of Asiatic origin. It will also raise doubts as to many of the inventions that were posthumously attributed to Terpander, to Pythagoras, and to other Greeks.

Lastly, perhaps the most interesting feature of all will be to establish, that the notes of the scale in "this dark backward and abysm of time," differed in no other way from modern notes of the minor scale (as on the long keys of a pianoforte, beginning on A), than in the manner of tuning the intervals called Thirds, (as from A to C and C to E,) so that,

although falling short of being consonant, as ours are, they would pass for Thirds in melody, and not every ear would perhaps then detect the difference, since it was but the eighty-first part of a string. If, after this, the ancient technicalities can but be successfully cleared away, the reader may have the whole subject of this most ancient music before his mind's eye. This will be here attempted.

Boeckh has remarked, in his *Metres of Pindar*, that "the music of the ancients is not merely neglected by the students of antiquity, but is buried in oblivion."[a] It is now quite time that it should be disinterred. It has indeed been allowed to remain an unravelled puzzle for many ages, and its complexities have seemed rather to increase than to decrease with the onward progress of time. The reasons for this have been various.

First, it presented a difficulty to the Romans because they had adopted but one portion of the Greek system, and did not trouble themselves overmuch about the remainder. Cicero thought that Aristoxenus had devoted his energies too exclusively to music;[b] and, when touching upon the art in his own writings, Cicero translated from Aristotle, and then Quintilian copied from Cicero. Vitruvius had to travel beyond the boundary of the Roman musical system when he wrote about the metal vases that were constructed within theatres to echo sound, and so to give resonance to the voices of the actors. He then described Greek musical literature as "an obscure and difficult subject," and one that could not

[a] "Veterum musica non modo negligitur ab antiquitatis studiosis, sed oblivione sepulta est."—(*De Metris Pindari*, lib. iii., c. 7, p. 204.)

[b] "Quantum Aristoxeni ingenium consumptum videmus in musicis."—(*De Finibus*, lib. v. 19.)

be explained without resorting to Greek words, for which there were no Latin equivalents. Although he endeavoured to understand and to explain the writings of Aristoxenus, he did not always succeed in giving correct interpretations of his author.[a]

Many such imperfect renderings might be cited from Roman authors, but it will now suffice to pass on to two of the latest writers under the old empire. Their works exercised the greatest influence upon the music of the middle ages. These were Cassiodorus and Boethius, who were cotemporaries in the sixth century, in the reign of Theodoric, the Ostro-Goth.

Cassiodorus was a Christian who wrote upon the liberal arts generally, and devoted but a part of his treatise to music. He included only the branch of Greek music that had been adopted by the Romans, viz., the ordinary Diatonic scale of tones and semitones, like our own, but in its early Pythagorean, or unimproved, state. His treatise is, so far, a good and brief summary, and it includes the ratios of the simple consonances, such as the Fourth, the Fifth, and the Octave. But when he touches upon compound intervals, it is not good. For instance, he says, or has been made to say, that an Eleventh, (*i.e.*, a Fourth added to an Octave,) is a consonance,

[a] For example, in describing the fixed sounds of the Greek system, he forgot that the lowest note of every scale (*the proslambanomenos*) did not form part of any one of their tetrachords, or Fourths, and he omitted two of the variable notes in his enumeration, viz., the *paranētēs* of the *synemmenōn* and *hyperbolæōn* tetrachords. Of the difficulties of Greek music, he says:—"Harmonica autem est musica litteratura obscura et difficilis; maxime quidem quibus græcæ litteræ non sunt notæ: quam si volumus explicare, necesse est etiam græcis verbis uti, quod nonnulla eorum latinas non habent appellationes. Itaque, ut potero, quam apertissime ex Aristoxeni scripturis interpretabor."—(Lib v., *cap.* 4, *Leipzig*, 8vo. 1807, p. 121.)

and that it is in the ratio of 24 to 8[a] (which would be as 3 to 1), whereas it is not a consonance, and is not in the ratio of 24 to 8, but of 8 to 3. To treat an Eleventh as a consonance was a common error, for which he had respectable authority, but not for mistaking its ratio.

The work of Boethius (*De Institutione Musica*) is the most elaborate of the Roman treatises, and one devoted exclusively to music. It is divided into five books, each subdivided into some twenty or thirty heads, or chapters. The last book exists only in an imperfect state. Boethius seems to have intended it to consist of thirty chapters, of which but eighteen are extant. The index of contents shows that the last twelve were to have been devoted to a summary of the suggestions and improvements of the later Greek writers, and especially to those of Claudius Ptolemy. But the summary was to have been historical only, because he had already formed his calculations of musical intervals upon the antiquated system of the Pythagorean scale. That was the adopted scale of the Romans, and his calculations upon it had been embodied in the preceding books of his treatise.

Boethius, in contrast to Cassiodorus, seems to have paid more attention to the science than to the art of music. He was an able arithmetician, but fell short of the attainments necessary for a great writer upon the theory of music. Yet he exalted theory greatly above practice.[b] His acquaintance with the

[a] "Quarta, Diapason simul et Diatessaron, symphonia est, quæ constat ex ratione quam habet xxiv numerus ad octo numerum: fit autem ex sonitibus undecim." — (Cassiodori *Institut. Musicæ*, apud Gerberti *Scriptores Eccles. de Mus.* i. 17.)

[b] "Quanto igitur præclarior est scientia musicæ *in cognitione rationis* quam in opere efficiendi, atque actu!"

practical branch of his subject was evidently slight; indeed, so slight that he seems not to have known the correct names for the strings of the lyre. He applied the title of *lichanos*, or fore-finger string, to two that have not that name in the work of any extant Greek author, and they were strings which the Greeks intended for the plectrum. The Romans had Latin designations for the strings long before the time of Boethius, which may account for his imperfect acquaintance with the Greek nomenclature.[a]

Boethius should be ranked rather as a man of general learning than as a remarkable musician. He adopted Claudius Ptolemy's theory, that the combination of an Octave with a Fourth above it, is a consonance,[b] against which the Pythagoreans had systematically, and (as will be hereafter clearly proved) had rightly contended. But still he had only read Claudius Ptolemy's works superficially, or else he would not have given currency to the popular story of Pythagoras and the hammers—that Pythagoras discovered the law of musical consonances through passing a blacksmith's shop, and weighing the hammers that were striking Fourths, Fifths, and Octaves upon an anvil. Ptolemy denies the possibility of such consonances from one anvil (in his third chapter of Book I.), and even a little reflection might have taught Boethius that the tone of a bell cannot

And again:—"Multo enim est majus atque auctius scire quod quisque faciat quam ipsum efficere quod sciat; etenim artificium corporale quasi serviens famulatur, ratio vero, quasi domina, imperat." —(*Inst. Mus.* i. 34, under "Quid sit Musicus.")

[a] In *Inst. Mus.* i. 22, he writes of *lichanos synemmenōn*, and of *lichanos diezeugmenōn*, which are both in the treble of the lyre, above the key note, and were to be played by the plectrum. Therefore the Greeks called them *paranētēs*, instead of *lichanoses*. Lichanos is the "licking" finger, or fore-finger.

[b] *Inst. Mus.* i. 12.

be altered in pitch by changing the weight of its clapper.

Boethius did not adopt the improvements either of Didymus or of Ptolemy in the musical scale, but retained the old Pythagorean system of major tones only, instead of alternating major and minor tones. Hence all his intervals of Thirds (whether major or minor Thirds) were discords instead of concords. Yet Didymus had shown the way to produce true consonant major and minor Thirds, five hundred years before the date at which Boethius was writing. Claudius Ptolemy had again demonstrated it, by inverting the succession of tones, about a century after Didymus, so that if Boethius had been a sound theorist or a practical musician, he could not have failed to discover, in the one case by the Pythagorean law of consonances, and, in the other, by his ears, how great was the improvement of turning those discords into concords, and, at the same time, improving the proportions of the so-called semitone.

Again, if Boethius had been well versed in the history of Greek music, he would not have handed down a series of stories that this man, and that man, added a new string to the lyre—as if it were to be understood in a literal sense. He would have discovered the chronological (as well as other) contradictions which such claims involved, and that "adding a new string to the lyre" could but be an ancient idiom for having introduced some approved novelty into the arts of poetry and music.

For these various reasons Boethius does not merit so high a rank among ancient writers on music as has been conceded to him in England, by making his treatise the text-book in our Universities.

No Roman of antiquity is known to have made, or even to have attempted, any improvement in the science of music. The Romans received the Diatonic Scale, of tones and semitones, from the Greeks at a time when it existed only in its primitive and imperfect form. Nevertheless they were content to retain it so, and did not follow the Greeks in any subsequent improvement. It is for that reason Greek music cannot be effectually learnt from Roman writers.

The treatise of Boethius having been the most complete that had been written in the Latin language, and being supposed to teach the best system, was unfortunately adopted as the text-book in the middle ages. It had a very retrograde effect upon music, one of the evils being, that it kept up the use of an antiquated and ill-divided scale to the time of Guido d'Arezzo, who taught and revived it in the eleventh century.

In after ages Boethius, in some way, gained the repute of having been a Christian philosopher. This may have been, because his system of music had been adopted in the Church. It is possible, also, that he may have been mistaken for another person of that not uncommon name, for no one could have written upon music less in the manner of a Christian than the author of the *Institutio Musica*.

In a treatise on music of early date, a man could but with difficulty avoid giving an indication of his religious creed, and a Christian especially would almost surely make some sign of his belief, unless he had a direct interest in avoiding it. There was no motive like that of a general persecution to induce concealment at the time Boethius wrote, so that, if

any one should now be curious as to the religion of that able writer, he may perhaps satisfy himself that there is not a symptom of Christianity about his writings on music. The contrast of style will be apparent on comparing a few of the corresponding pages in the treatises of the two cotemporaries, Cassiodorus the Christian, and Boethius the philosopher of questionable creed.

A second element of confusion to the student of Greek music arose from the employment of Greek words in ecclesiastical music, where they were applied in senses sometimes opposite, and at other times differing materially from classical Greek.[a] As one instance, the alternate singing of verses of psalms by a choir divided into two parts, was introduced from Antioch in the fourth century. One half of the choir sang one verse, or part of a verse, and the other half responded, either with the next verse, or with a burden, such as, "For His mercy endureth for ever," in Psalm No. 136; much like the present practice in our cathedrals. It was a Syrian and a Jewish manner of responsive singing. The Song of Triumph of Deborah and Barak (Judges, chap. v.), and Psalms, such as Nos. 103 and 104, were evidently designed for it;[b] but it was not before practised by the Greeks, or else it would not have been a novelty. Yet a Greek term was soon appropriated for it, but in quite a new sense. It was called "antiphonal"

[a] "Quippe medio ævo qui artem excoluerunt, quum et instrumenta plurima extincta essent, et ars ipsa pridem conticuisset, nominibus ex arte relictis ita sunt abusi, ut novis inventis accommodarent nulla ratione prioris significationis habitu; ex quo factum est ut non solum immutaretur vis vocabuli cujusque, sed etiam prorsus inverteretur."—(*De Musicis Græcis Commentatio*, Joannes Franzius, Ph. D. Berlin. 4to. 1840.)

[b] Philo Judæus, who was born about twenty years before Christ, refers to the double chorus, and the

singing; but the meaning of the Greek *anti*, as usually applied to music, is in the sense of "accompanying," and, therefore, in that of the Latin *cum*, "with," and not of *pro*, or *contra*.[a] Instead of being responsive, like the chants in our cathedrals (which in Greek would be called *ameibomenai*[b]), Greek *antiphōns* were simultaneous sounds an Octave apart; and therefore like our congregational singing, wherein the voices of men intermingle with those of women and children. The voices of the men, being naturally an Octave lower than the others, make the *antiphōns*. Thus, Greek *antiphōna* were fellow or companion sounds, harmonious and concordant. The graver of the two notes of the Octave, says Aristotle,[c] "is the *antiphōn* and concordance to the upper; they result from young boys and men singing together." (Some of the latest writers include double Octaves as *antiphōns*.) Aristotle says that, although Fourths and Fifths are also consonances, yet they are never sung in sequences to make *antiphōna*,[d] as are Octaves.[e] In this respect Greek ears agreed with our own. Ample definitions are found in the works of Plato,[f] of Aristotle

burden of hymns among the Jews, in his treatise on the tilling of the earth by Noah, i. 313, cap. 18. "But the same hymn is sung by both the choruses, having a most wonderful epode, which, to be sung after the hymn, is beautiful." He then gives the words of this epode, Exodus xv. 1, "Let us sing unto the Lord, for he hath triumphed gloriously; the horse and his rider hath he thrown into the sea." Moses led the men, and Miriam the women, for "they were the leaders of the choruses," as he tells again in his "Life of Moses."

[a] The English word *counter*, as compounded in *counterpart*, and, in music, in *countertenor* and *counterpoint*, seems better to express the Greek *anti* than the Latin *contra*, or our *against*. Counterpoint is simultaneous harmony, or note *with* note.

[b] See *Iliad*, book i. lines 603-4.

[c] Prob. vii., xiii., and xlvii. of Section 19.

[d] See Prob. xvii. of Section 19.

[e] Prob. xviii. of Section 19.

[f] It may be desirable here to note, in anticipation, that συμφωνία means "concordant sound" (not "symphony") and is opposed to διαφωνία, "unmixing sound, or discord." και ὀξύτητα βαρύτητι σύμφωνον καὶ ἀντίφωνον παρεχομένους.—Plato's *Laws*, 812.

(many),[a] of Plutarch,[b] and his cotemporary Theon of Smyrna,[c] of Gaudentius,[d] of Psellus, in the eleventh century,[e] and of Bryennius, in the fourteenth,[f] thus carrying down the classical meaning of the word *antiphōn* to the Byzantine-Greek, in the time of the Emperor Palæologus the elder, about 1320.

As the translations of so many passages in classical authors are affected by this *anti,* a few more cases should be cited before passing from the subject. The oldest of our extant lexicons are not here to be much depended upon. In that of Hesychius, *antichorda* are first explained as "companion strings" ("*σύγχορδα*"), which is right; but, secondly, as "equal strings" ("*ἰσόχορδα*"), which is not right, according to classical authors. The second definition was probably interpolated to agree with the meaning adopted in the Western Church, for strings an Octave apart could not be "equal." The Greek *antichorda* were always Octave strings, and *proschorda* were the "equal strings," or unisons. They are so explained by Plato, by Aristotle, and by Plutarch. When Plutarch states that Archilochus was supposed to be the first person who played an accompaniment on the lyre under the voice part, and that the ancients had always before played

[a] "Τὸ *μὲν ἀντίφωνον σύμφωνόν ἐστὶ διὰ πασῶν; ἐκ παίδων γὰρ νέων καὶ ἀνδρῶν γίνεται τὸ ἀντίφωνον.*"—Arist. Prob. xxxix. of Section 19. See also Nos. 7, 13, 16, and 17 of the same section.

[b] "Ἡ *μὲν περὶ ψαλμοὺς καὶ φόρμιγγας ἁρμονία δι' ἀντιφώνων ἔχει τὸ σύμφωνον.*"—Plutarch *De Amicit. multit.* 96 F.

[c] "*σύμφωνοι κατ' ἀντίφωνον.*"—Theon, 77, edit. Bullialdus, Paris, 1644.

[d] "*καὶ μέσην τὴν πρὸς τοῦτον (προσλαμβανόμενον) ἀντίφωνον.*"—Gaudentius, p. 21, l. 8, edit. Meibom. The two strings here named were invariably an Octave apart.

[e] "*ἡ δὲ διὰ πασῶν, καὶ ἡ δὶς διὰ πασῶν κατ' ἀντίφωνον.*"—Psellus, per Meibom. Note on Gaudentius, p. 36.

[f] "*τὸν ἀπὸ τῆς νήτης πρὸς τὸν ἀπὸ τῆς ὑπάτης ἀντίφωνον κατὰ τὴν διὰ πασῶν.*" Bryennius, edit. Wallis, p. 365, line 32.

"in unison" with it, he expresses the "unison strings" by *proschorda*.[a] *Antiphthongus* and *antipsalmus* are two other words that equally express simultaneous (Octave) sounds. The first is used as a synonyme for *antiphōn*, by Pindar, as quoted by Athenæus.[b] Again, *antispasta melē*, and *antispasta sunchordia*, quoted by him from Phrynichus, and from Sophocles,[c] (both meaning "Octave accompaniment,") and *antitheton* for *antiphōnon*, by Aristotle.[d]

Again, the *antipsalmus* must necessarily have had the accompaniment of the hands upon a stringed instrument to constitute a "psalm," but Hesychius omits that part of the definition—possibly because stringed instruments were not in his time used in the Church.

The antistrophes of Greek plays are beyond the scope of the present enquiry, but the musical part of the evidence seems to run in the same direction. When Aristotle asks, "Why are neither Hypo-Dorian nor Hypo-Phrygian choruses sung in tragedies? Is it because they have no Antistrophe?"[e] One sufficient musical reason for not having any would be, that they were the two lowest base scales, and it was impossible for men to sing Octaves below

[a] "*οἴονται δὲ καὶ τὴν κροῦσιν τὴν ὑπὸ τὴν ᾠδὴν τοῦτον πρῶτον εὑρεῖν, τοὺς δὲ ἀρχαίους πάντας πρόσχορδα κρούειν.*"—Plutarch *De Mus.*, cap. 28. See also Plato's *Laws*, 7, 812. He did not see the necessity of teaching boys a varied accompaniment upon the lyre, or the art of showing off upon the instrument, but wished that they should be taught to sing and play in unison ("*ἀποδιδόντας πρόσχορδα τὰ φθέγματα τοῖς φθέγμασι.*") Again in Aristotle's Prob. ix., Section 19, *πρόσχορδα ᾄδειν.*

[b] "*Τὴν μάγαδιν ὀνομάσαντα ψαλμὸν ἀντίφθογγον, διὰ τὸ δύο γενῶν ἅμα καὶ διὰ πασῶν ἔχειν τὴν συνῳδίαν, ἀνδρῶν τὲ καὶ παίδων.*"—(Athenæus, lib. xiv., Sec. 36, and again in a second quotation from Pindar, Sect. 37.)

[c] Idem, Sect. 36.

[d] Aristotle's Prob. xvii. of Sect. 19.

[e] Aristotle's Prob., Sect. 19. Prob. xxx. and Prob. xlviii.

them. Whether that was or was not the reason, and whether antistrophes were ordinarily sung in Octaves, or an Octave lower than strophes, must be submitted to those who have studied the subject. Aristotle is good authority for the lack of *antistrophe* to the two lowest base scales.

Octaves are the simplest form of consonance, and the first step towards the power of appreciating other double sounds. Abundant evidence may be found of the estimation in which this simplest and most perfect of all harmony was held by the Greeks from very early date, and also by the Egyptians before them. Anacreon, who is said to have flourished about 540 B.C., used to accompany his voice upon a ten-stringed instrument, in which each of the strings was divided into two parts, so as virtually to make twenty, but ten were tuned in Octaves to the others. That instrument was derived from Egypt; but its ordinary compass, Egyptian or Greek, was of seven, instead of ten strings. The name, *Magadis*, may have been compounded of *magas*, a bridge for a musical instrument, and *dis* twice. The double bridge which divided each string into two parts was at about a third of the sounding distance up the string, so as to make one end double the length of the other; because half the length of any equal sized string must sound an Octave above its whole length. This instrument, which has hitherto been waiting for identification, will hereafter be shown, both in its Egyptian and in its Greek form.

Long after the form of instrument used by Anacreon had fallen into disuse (or was perhaps employed only in the worship of Athēna), the verb *magadizein*, "to magadize," was retained in the

language to express "playing in Octaves" upon any instrument whatever. Thus, even double pipes, that could have no "bridges" to entitle them to such a name, were called *Magades*, if one of the pipes was tuned an Octave below the other.

The words that relate to music, in modern languages, are mostly derived from the Greek, and yet there is scarcely one among them (even one of commonest use) that retains its original meaning. The prime cause of these deviations is our indirect inheritance of such words. We owe them mainly to their having been appropriated for early Church music, and there was a mediæval taste for giving Greek names to everything musical, even though as misapplied as in the case of *antiphōn*. If the words were then received in their new sense, it would matter little what ancient Greeks might have said to them.

In order to exemplify the deviations that thus arose, and the trouble they have given to after-enquirers, a few of the most ordinary words will be now cited.

The Greek *Harmonia* is quite a different thing from modern "harmony," whether in its French, Italian, Spanish, or English sense; neither is it a synonyme for our "melody," as many learned men have supposed—including Dr. Franz, of Berlin,[a] and Dr. Burney, who followed Mason's definition. It will be here proved to mean "The System of Music," or briefly "Music," of which melody and harmony are each but parts. For a short time the Enharmonic scale was so much in favour (owing to the popu-

[a] Dr. Franz, in his *De Musicis Græcis Commentatio*, says—"Harmonia veteribus est certa quædam consecutio sonorum secundum grave et acutum; itaque id quod nos fere melodiam vocare solemus."

larity of the omission of Fourth and Seventh in a scale), that scarcely any other than enharmonic was used, and so, for awhile, the teachers of that system assumed the general name, applicable alike to all. Aristoxenus comments upon this usurpation. But their system soon dropped out of favour, and not long after, out of use. Again, *Melōdia* is not at all the equivalent to our "melody," nor had Greek music given birth to what we should consider "melody," at the time the word was first used. Greek *Melos* had not necessarily any tune in it. It applied to the rising and falling sounds of the voice when linked together in speech, or in rhythm, as well as in music; so that recitation, without any musical intervals in it, would still be *Melōdia*. Thirdly, *Harmonikē* does not mean "harmonic," or "harmonics," but is a synonyme for *Harmonia*. Again, *Sumphōnia* does not mean "symphony." The last expresses our "harmony," viz., "concord of notes of different pitch." Even music (*Mousikē*) in Greek had so extended a sense as to render necessary more precise words, such as *Harmonia*, or *Harmonikē*, to express the more strictly musical parts of it The mental training of a young Greek was included in the word *Mousikē*, and it comprehended all that related to the sciences of sounds and numbers, as well as to their application in practice.

A fourth element of difficulty for the student of Greek music was in the ecclesiastical scales. They are not of the early date that has been supposed; and, although they differed essentially from Greek scales, they were called Greek, and had Greek names given to them. The origin of Church music will require a chapter, which it is unnecessary to anticipate, but it

may be observed here that Church writers condemned all music which was not constructed upon the ecclesiastical system as false. They asserted their own to be the only true ancient music. For this they had the authority of Popes, such as John XXII., who declared all systems that differed from the ecclesiastical to be frivolous novelties. It was safer in those days to be orthodox, than to exercise private judgment against the traditions of the Church. Ecclesiastical courts had wide jurisdiction, and very sharp claws.

Such a series of misleading elements will sufficiently account for the ill-success of many learned men who tried to discover what Greek music really was. It would hardly be suspected that the meaning of ordinary words, which everyone is supposed to know, must first be rejected. Therein lay the difficulty of translating many passages relating to music in the works of classical authors. Latin translations are of no use, because the Greek words are varied only as to their terminations. Such translations were easy enough to make, because they did not demand that the translator should understand his subject. There remains, also, sufficient evidence that advantage was taken of that license.

As if there were not already a sufficient number of intricacies in the pathway to Greek music, a glance at the works of some of the late German historians shows that they have imported into it a new element of complication. Beginning the study, as some may think, at the wrong end, they would first settle which of the modern notes will most faithfully represent the supposed ancient Greek pitch. That in itself is but a speculation, for there

are no certain grounds to go upon; but when historians follow it up by altering the names of the Greek scales to correspond with modern ideas of pitch, they dissever those scales from all their historical associations. If we look into the work of a modern German author for the Hypo-Dorian or "Common" Greek scale, it is no longer to be identified with the "Natural" scale, the *scala dura*, (as on the long keys of the organ or pianoforte, beginning on A,) as it used to be, and still is with us. The Germans have changed it to one beginning on A flat, or on some other note. Thus the important historical link between the ancient "Common" scale, and the modern "Natural" scale has been set aside. Secondly, the basis of Plain Song, or "Gregorian" music, rests upon the combination of the Greek Dorian and Hypo-Dorian scales, (D minor and A minor,) but that is also rendered unintelligible, and seems even to be contradicted by the alteration, from A and D, to A flat and D flat. Thirdly, the long keys of the pianoforte were inherited from, and still identify, the Common Greek scale, but that link is dissevered, as well as between the keyboard of the modern, and that of the ancient organ, by the change of scale. The ancient organ was a Greek instrument, and one of such early date, that it had advanced to the stage of being fitted with a keyboard, and being played by the fingers (not requiring the entire hand,) more than a century before the Christian era, as will be shown hereafter.

It is undoubtedly true that the pitch of musical instruments has been raised since about 1750. The increase of tension in the present century has been mainly owing to the improved manufacture of strings,

both in catgut and in wire, but especially to the introduction of the steel wire of Sheffield, which enables strings to bear greater tension than the Berlin iron of former days. So it is probable that the A flat of to-day may very nearly represent the A of a hundred or more years ago. But although a pianoforte may sink half a note below the pitch of the tuning-fork, and will therefore require to be raised half a note, we do not on that account think it necessary to alter the names of the keys, or of the notes. No musician would think of changing the name of Beethoven's Symphony in C minor, to C flat minor, or to B minor, because our B might more nearly represent the pitch in Beethoven's time. Considering, too, that we have even yet no standard pitch for Europe, and are not likely to have one until the French will be guided by their men of science, and slightly modify their present law; also that the only directions hitherto found among Greek authors are, that every man should tune his lyre by the lowest audible note of the voice,[a] it will be time to discuss the question of ancient pitch, when it can be shown that the Greeks had a universal standard.

Dr. Burney, indeed, offers a speculation about ancient standard pitch, when he says that a *sepulchral urn* found in the first pyramid of Egypt sounded like a bell, adding, "if it be true that the Greeks had their first musical knowledge from Egypt, we may suppose this to be the standard pitch" of the Greeks.[b] To receive such a doctrine will require more imagination than many possess. For we have first to suppose that a sepulchral urn was intended

[a] See Gaudentius, p. 22. [b] *History* i. 278, note x.

to be a musical instrument, and next, to assume that, after five thousand years, the original weight and density of the metal remain to assure us of that "original pitch." In the meantime, we may be content to believe in the great probability of variations in pitch in different cities of Greece, and even in the same city at different times, yet that the modern A still sufficiently represents "the lowest distinctly audible note" of an ancient Greek's voice, as it does of many voices at the present time. All that can be known with certainty is, that ancient instruments must have been tuned alike when they were to be played together.

The principal difficulties in the path of all students of Greek music have now been enumerated, but there has always remained one direct course to learn the Greek system, viz., to go to the fountain head, and to endeavour to work through, and find the meaning of, the technicalities, without seeking help from the labours of others in the same field. If they failed, even partially, it would not be safe to copy from them.

This has been found too time-consuming a course for able men who desired to know only enough of Greek music to enable them to write about it. They prudently judged that, when the value of time must be taken into account, any entirely new history upon so intricate a subject would offer but the slenderest prospects of a compensating return. That is indeed the main reason why the world has been allowed to remain uninformed to this day, and it has been my inducement to take up the subject.

If the present attempt shall be judged to have succeeded, it will, perhaps, be attributable to the fact, that the study was undertaken solely for the sake

of obtaining better information than histories of music have hitherto afforded. After having read the published works of mediæval authors upon music, and the unpublished contained in the British Museum, the Bodleian Library, and the Lambeth Library, I next took up Greek music, as of old a book of chess problems, for the employment of my leisure time. Only after the Greek problem had been unexpectedly solved, and the solution had been tested against the difficulties which Boeckh had pointed out in his *Metres of Pindar*, as well as against many indicated by others, did the first thought of writing down the results of reading occur to me. The amusement of investigation was at an end, and no other *terra firma* for a new problem seemed to offer.[a] Desiring a new occupation, it then appeared that my leisure might be usefully employed in dispelling the mystery that had hung about Greek music. Moreover, there was a wide field in other branches of history, such as the debt of the Greeks to Egypt—a different version of the origin of ecclesiastical tones or scales, and of the kind of notation in which the Chanting marks for ancient Church services were written—a new account of the revival period, and to show music in England on four or five lines and spaces before the time of Guido, to whom much has been attributed, but who was rather behind than before his age—then to explain the only true principles for all music, and to prove them, so that any one, who only knew the notes, might follow and understand them. There were also many scraps of

[a] This proved to be a mistake when history was commenced. There were then problems in plenty remaining—Hebrew instruments to wit, with Josephus, Philo, the Septuagint, Trommius's Concordance, the Hexapla, &c., to be searched, for, perhaps, a page in print.

information that had not been included in any history, and which, in the words of Mr. Timbs, would be "Things not generally known."

The field was indeed ample, but (writing history not having been contemplated,) no sufficient provision had been made in the shape of notes upon former readings, and there was the irksome task of going over the same ground a second time, under the disadvantages of worn sight, and other warnings of the advance of time. Hard work was in prospect, for only they who have tried the experiment can tell the time it may take to find even one missing link. Still, the main points of history have hitherto been so inadequately developed, and there has been such copying from untrustworthy writers,[a] as well as from one historian by another, that any one branch re-written promised to be of some use.

[a] To give one instance, how many have quoted from Athanasius Kircher! This writer's place has been mistaken. He deserves a very high rank in the history of fiction, for he was a most imaginative man. He gave explanations of hieroglyphics, *more suo*, although no clue to the interpretation had been discovered in the seventeenth century, when Kircher flourished. He published those interpretations, in three volumes, under the title of *Œdipus Ægyptiacus.* His *Musurgia Universalis* (a misnamed book upon all branches of music,) is of the same class as his work upon hieroglyphics. It is equally imaginative, but more dangerous, because, as in historical novels, there is a smattering of truth, but even that is commonly perverted for the sake of making a good story. Meibomius said, in his introduction to the Greek authors, that there were at least two hundred errors in Kircher's table, at p. 541 of his *Musurgia.* There are too many mis-statements as well as errors to make it worth while to count the number in one table; but, as a work of imagination, it does great credit to his memory.

CHAPTER II.

Preamble of how modern music is indebted to the Greeks.—Great similarity of systems.—The Greek maiden's song like modern minor music.—The ancient minor scale parent of the major.—Deductions about Egypt and Babylon.—Music in the time of Homer.—Lyre of the Greek Hermes.—Terpander's seven strings.—Use of but three strings in Homeric recitations.—Early Greek scale of seven notes.—Its association with the seven planets.—What such a scale was fit for.

Greek music cannot be considered as one of those subjects of ancient history with which modern science and art have but little concern, for not only has it been the progenitor of the musical system of Europe, but even now it is largely adopted, without improvement or change.

It will on that account be convenient to explain it by the terms of modern art, so soon as identity of meaning shall have been established, and thus relieve the reader from a mass of ancient technicality. Such terms, also, as relate to modern practice will be explained *pari passu*, for, although familiar to musical readers, it is an object to be even more widely intelligible. Dr. Burney described Greek music as "a dark and difficult subject" and one that had "foiled the most learned men of the two or three last centuries" (*History* i. 7.); but no other difficulties really existed either for him or for them, than in certain words, and in the ancient technicalities. The music itself is simple in the extreme. The same

comment will apply to Sir John Hawkins's remark, that "Even at this day the ablest writers on the subject do not hesitate at saying that the doctrine of the [Greek] modes is absolutely inscrutable." (*History* i. 236, 4to.)

One branch both of the science and of the art, in which music is still governed by Greek laws, is in the mathematical, and practical, divisions of notes in the scale. They are precisely the same now as in the days of the Ptolemies, save in the new-found "equal temperament" which (introduced for the sake of imperfect instruments) means "putting all keys equally *out* of tune." Whether the strict adherence of the moderns to models of antiquity, as to the formation of the scale, has been for the best, is one of the questionable cases that will be submitted to the judgment of the reader hereafter.

The present musical scale is a re-adjustment of the Pythagorean, by the Greek mathematician, Claudius Ptolemy. The notes are, therefore, the same at this day (when played in tune) as in the first half of the second century of the Christian era.

The Greeks had scales beginning upon every semitone of the Octave, and, therefore, every sharp and flat that we now have.

Every principal Greek scale had what, in modern technical language, we call its "Dominant" and "Sub-dominant," *i.e.*, the Fifth and Fourth above the key-note, upon which new scales, connected with the key, begin. The Greeks expressed those connected scales by the words "*Hypo*" or "*Hyper*" prefixed to the original name—as, Dorian, Hypo-Dorian, or Hyper-Dorian. The Hypo scale began a Fourth below the key-note of the principal scale,

(which is the same as a Fifth above it,) and so answered to our "Dominant;" and the Hyper began a Fourth above the key-note, and so exactly like our "Sub-dominant."

Here, then, is a complete system resembling our own as to its keys, as to its familiar modulations, and as to the tuning of its notes. The music of a Greek maiden accompanying her voice upon the lyre, or other instrument of the harp kind, nearly two thousand years ago, could hardly be distinguishable from the minor airs of modern Europe; and the resemblance would be further strengthened by the Greek maiden's strict observance of her key-note, which was quite as strongly enforced by Greek musical laws as by our own.

There could be but one difference between the two, and that would hardly be brought into play. The Greeks played and sang in minor keys only, and their Seventh of the key was the old minor Seventh, or whole tone below the Octave, in ascending as well as in descending. (In Dr. Burney's time, this minor Seventh was called "flat" Seventh, and the major Seventh, which is only half a tone below the Octave, was called a "sharp" Seventh; but, as they do not necessarily fall upon flats or sharps, those names have been discarded.) The minor Seventh was an integral part of the old minor scale, as the major Seventh is now of the major. An important piece of history is attached to the old minor, that out of it grew the comparatively modern major scale, by beginning upon the third note instead of the first. Thus, beginning on the pianoforte upon C instead of upon A, we change the ancient key of A minor into the modern C major. A, B, C, D, E,

F, G, is the ancient scale. There could be no such thing as a complete major scale under Greek laws, because the Seventh was always to be a tone below the key-note.

Many interesting deductions may be made about ancient music, and these will tend to raise the subject above the technicalities and the mere history of the art, if the reader will but employ his thoughts to bring them out. For instance, the character of the music of ancient Egypt and Babylon may be ascertained by a train of evidence that will leave very little doubt on the subject; and, by looking at the drawing of an ancient Egyptian instrument with a long neck, (only supposing the drawing to be an accurate representation,) he may know, with mathematical certainty, how many notes were, or could be, played upon every string. The manner of ascertaining it will be further explained. The present preamble is to prepare the reader to believe that ancient music has some certainties about it, and is, by no means, the uninteresting or doubtful study that many might suppose. And now to history.

From the time of the Homeric poems to that of Terpander, (which is supposed to have been about the middle of the seventh century before Christ,) the lyre of the Greeks had but four strings. They were made of sheepgut, which is now technically called "catgut."[a] While the number of strings was limited to four, the lyre must have been used rather as the substitute for a pitch-pipe to guide in the recitation

[a] The word seems to require explanation; for M. Fétis, quoting from Sir J. Gardner Wilkinson, and not looking into a dictionary, wonders that the ancient Egyptians should have used catgut, considering their respect for "cats." — (*Hist. de la Musique* i. 268-9.)

of epic poetry, than as a musical instrument. Nothing like tune could be played upon it, but still there would have been music in the Greek sense of the word, since there was a combination of recitation, metre, and rhythm. In the Odyssey we read of a skilled singer and player on the lyre, *(Phorminx,)* as having changed his chant "to a new string upon a new peg."[a] That was the entire musical change, and it was evidently to raise or lower the pitch of his voice in recitation, to suit a new sentiment in the poem. We may imagine his chant to have been something like what is now called "intoning" or "monotone." Monotone practically means only taking a pitch for the voice, for the articulation of the vowels in speech would alone forbid monotone in a literal sense, since they of themselves form an ascending or descending scale of sounds.[b] The custom, that an orator should have a lyre or a pipe by him to regulate the rise and fall of his voice, endured for many centuries after the time of Homer.

Greek writers give two different accounts of the origin of their music; on the one side attributing the discovery of their lyre to the Greek Hermes, son of Zeus and Maia, daughter of Atlas, and on the other to the Egyptian Hermes, or Thoth. He was the god of learning, and was commonly represented by a human figure with the head of an ibis, holding a tablet and a pen, or a palm branch in

[a] "*Ὡς ὅτ' ἀνὴρ φόρμιγγος ἐπιστάμενος καὶ ἀοιδῆς,*
Ῥηϊδίως ἐτάνυσσε νέῳ ἐπὶ κόλλοπι χορδὴν,
Ἅψας ἀμφοτέρωθεν ἐΰστρεφὲς ἔντερον οἰός."—*Odyssey* lib. xxi. li. 406-408.

[b] This fact has been largely illustrated by Willis (in the Cambridge Philosophical Society's Transactions v. 3, p. 231,) and by Helmholtz, but the Greek cry for woe, "ouai," will suffice for the experiment. Every one will find a difficulty in adhering to one uniform pitch of voice while pronouncing it.

his hands. At other times he has a man's face, with the crescent of the moon upon his head, supporting a disc. Attention has not been sufficiently directed to the difference between these two accounts. The first refers to the primitive Greek system, before the Greeks had learnt anything of music proper; and the second to their later system, which was real music, and obviously borrowed from countries of more ancient civilization, especially from Egypt and Babylon. The first relates to the kind of scale that is made up by joining one series of four notes, called a tetrachord,[a] to another series of the same, and making the highest note of the one serve in the double capacity of lowest note to the other, as B, C, D, E—E, F, G, A. The second account refers to the embodiment of the tetrachords into the Octave system, as if beginning and ending on our A.

The story of the former god is told with more detail in the Hymn to Hermes, (at one time attributed to Homer,) than by Apollodorus,[b] or other writer. This hymn is obviously of later date than the Iliad or the Odyssey.[c] It includes the story of Hermes stealing the oxen of Apollo, one of the fables said to have been invented by Alcæus of Mitylene.

According to the hymn, Hermes, soon after his birth, found a mountain tortoise grazing near his

[a] *Tetra,* in composition, means "four," and *chordē* means both a string and a *note,* so a tetrachord may be four strings or four notes. This second sense of the word chordē is of most common application in tetrachords, but it seems to have escaped the notice of some translators from the Greek, including those of Julius Pollux's *Onomasticon.*

[b] Lib. iii. cap. 10.

[c] Bunsen has inferred the date of Homer to have been between 900 and 850 B.C., from the mention of the hundred gates of Thebes by Achilles in Iliad ix. 379-385. (*Egypt's Place in Universal History,* by C. C. J. Bunsen, D. Ph., and D.C.L.) The last edition of Liddell and Scott's admirable *Lexicon* gives Homer's date as "900?"

grotto, on Mount Kyllene. He disembowelled it, took its shell, and, out of the back of the shell, he formed the lyre. He cut two stalks of reed of equal length, and, boring the shell, he employed them as arms or sides[a] to the lyre. He stretched the skin of an ox over the shell. It was, perhaps, the inner skin, to cover the open part, and thus to give it a sort of leather or parchment front. Then he tied cross-bars of reed to the arms, and attached seven strings of sheepgut to the cross-bars. After that, he tried the strings with a plectrum.

This lyre of the Greek Hermes is like some that we see in ancient sculptures; but the two reeds are generally replaced by two horns, the curvature of which gives grace to the form.

The idea of these horns seems to have been borrowed from the Phœnicians, who, according to Herodotus (lib. iv. cap. 192,) used those of the large antelope of Libya, and of Egypt (the oryx) for their lyres. The Egyptians did the same, but sometimes used wood, and had ornamental heads of animals carved on the arms of their instruments.

The author of the Iliad and of the Odyssey speaks of the lyre only under its two most ancient names, *Phorminx*, or *Kitharis*, but never of its having seven strings. The Kithara seems to have differed mainly from the Phorminx in being of more portable size.

The writer of the hymn gives four names to the instrument, viz., Phorminx, Kitharis, Lyra, and Chelys,[b] (from *chelus*, the shell.)

[a] πήχεις, line 50. The lyre described in lines 47 to 51.

[b] M. Fétis asserts that, although the Chelys was a lyre, the Kithara was not. He might have guarded himself from that error by reading the Hymn to Mercury.—(*Histoire de la Musique*, i. 272 to 280.)

One of the late Greek writers, Manuel Bryennius, bridges over the difficulty of the seven strings mentioned in the hymn, by asserting that, before Hermes invented the seven-stringed lyre, men had used one having but four strings. According to Bryennius, the four strings represented the four elements, earth, water, air, and fire; and Hermes increased the number to seven, to represent the seven planets.

Mythology apart, we know with tolerable certainty the date at which the Greeks increased the number of strings on their lyres from four to seven, because the author of one of the earliest extant treatises on music, the *Introduction to Music*, ascribed to Euclid,[a] has preserved for us two lines from a poem by Terpander, which is as follows:—

> "But we, loving no more the tetrachordal chant,
> Will sing aloud new hymns to a seven-toned phorminx."[b]

Terpander here plainly states that the four-stringed lyre (still called Phorminx) had continued in use up to his own time.

[a] It can hardly be that the same author can have written the *Introductio Harmonica* and the *Sectio Canonis*, although both are ascribed to Euclid by Meibomius. The first is an excellent treatise upon Aristoxenian principles, (which Bryennius follows largely, often adopting the identical words, but without naming the author,) and the second is an admirable Pythagorean treatise. The two systems were opposed—the Aristoxenians relying chiefly upon the judgment of the ear, and the Pythagoreans upon mathematical calculations. (See Aristoxenus, p. 33. edit. Meibom.) The second is quoted as Euclid's by Porphyry, in his *Commentary upon the Harmonica of Claudius Ptolemy*. (See Dr. Wallis's *Opera Mathematica*, 3. 267.) With this reservation as to the authorship, we henceforth quote both as Euclid's, to abbreviate references.

[b] "Ἡμεῖς τοὶ τετράγηρυν ἀποστέρξαντες ἀοιδὴν,
Ἑπτατόνῳ φόρμιγγι νέους κελαδήσομεν ὕμνους."—(p. 19, Meibom's ed.) This is quoted by Strabo, p. 169, with a different reading in the first line (W. A. W.).—

"Σοὶ δ᾽ ἡμεῖς τετράγηρυν ἀποστρέψαντες ἀοιδὴν."

Boethius, while ascribing the invention of the seventh string to Terpander, supposes the planetary theory to have suggested it to him,[a] but it is far more probable that the increase was first made, and then the numerical coincidence with that of the planets, (of the ancients,) suggested the lyre as a subject for a Greek hymn. This hymn was most likely composed long after the time of Terpander, when his claim had been forgotten, and after the Greeks had learnt something of astronomy from Babylon and Egypt.[b] It was then they began to connect the revolutions of the heavenly bodies with musical sounds, and astronomy became one of their branches of music.

The arrangement of the seven strings, (the introduction of which into Greece may be attributed to Terpander,) was to tune them at the same relative distances of tone and semitone as are B, C, D, E, and E, F, G, A, or as E, F, G, A, and A, B flat, C, D, in the modern scale. Seven strings sufficed, because the highest string of the lower tetrachord served also as the lowest string of the upper series. This arrangement of the strings was called *Synaphē*, or Conjunction.[c]

Although the Greeks had every kind of Fourth, or *Diatessarōn*, that we have, yet, in arranging their tetrachords for the lyre, or for a scale, they chose the one form only, in which the interval of the semitone is between the lowest note and the next above it. (It may be necessary to explain to some readers

[a] "Sed septimus nervus a Terpandro Lesbio adjunctus est, secundum septem scilicet planetarum similitudinem." (Boethius *De Musica* i. 20.)

[b] Diodorus Siculus attributes the first observations on the order and system of the stars to the Egyptian Hermes.—(*Hist.* lib. i. 16.)

[c] "συναφῆ, ὧν εἷς γίνεται κοινὸς φθόγγος."—(Arist. Quint. p. 16.)

that a musical Fourth consists of two tones and a half, and a Fifth, of three tones and a half.) The Greek *Diapente* had the compass of our Fifth, as the *Diatessarōn* of our Fourth.

Late Greek writers attributed a second and improved arrangement of the seven strings of the lyre to Terpander, but that improvement must have been subsequent to the discovery of the Octave system. It has been attributed, with greater probability, to Pythagoras, who flourished more than a century after Terpander. The radical change involved in turning tetrachords into Octaves, shows that the Greeks had at that time begun to learn from other nations, either by colonization, by trade, or by the visits of musicians. Even then, such changes are of the slowest growth. In no art or science have changes been hitherto so slow as in systems of music.

As to the possibility of Terpander's having also introduced the second arrangement of the strings, it is very small, considering his date. He is said to have gained the prize at the first "musical" contest, at the feast of Apollo Carneius, in Sparta, B.C. 676. If so, that victory was gained before Egypt was thrown open to the Greeks, and at a time when guards were set to prevent the landing of foreigners by the sea. So, while "poetical" contest would be an equally correct translation, it would more accurately describe the nature of his victory. Philodemus, the Epicurean, who was cotemporary with Cicero, has distinguished between the music and poetry of the early Greeks,[a] and based the reputations of Orpheus, Amphion, and the rest, upon their

[a] *Herculanensium Voluminum quæ supersunt, Tom.* i. *Philodemi de Musica.*—Naples, ex regia typographia, fol. 1793, col. 6.

powers of recitation, and upon their poetry, far more than upon what we should call their music. If Terpander gained a prize B.C. 676, it must have been at least twelve years later before he would have been admitted into Egypt to learn anything. Egypt was first thrown open to the Greeks by Psammetichus I. Calculated by the Apis Tablets of the Serapeium as the surest guide to Egyptian dates,[a] the reign of Psammetichus, of fifty-four years, began in 664, and lasted to 610 B.C., and could hardly have commenced more than a year or two earlier.[b] The probable dates of Terpander and of his supposed cotemporary, Archilochus, are materially affected by that of Psammetichus, if either of them did all that has been attributed to them. One of the later myths about Terpander is, that he carried the lyre of Hermes to Egypt, and taught the Egyptian priests instead of learning from them. That story was dictated by Greek vanity. Plutarch says nothing of Terpander's Carneian victory, but that it is "on record" that he gained the prize four times in

[a] The Apis Tablets date back from the conquest of Egypt by Cambyses, B.C. 525. They record the deaths and burials of the sacred bulls.

[b] In Dr. W. Smith's *Dictionary of Greek and Roman Biography*, the reign of Psammetichus is given as from 671 to 617 B.C., but with the addition of a note that Boeckh dates the commencement of his reign in 654 B.C. Here is a discrepancy of seventeen years. As there is no date of greater importance in the history of Greek science and art than that of the reign of Psammetichus I., king of Egypt, and as Egyptian dates are now better understood than in Boeckh's time, I asked the assistance of Samuel Birch, LL.D., F.S.A., Keeper of Antiquities in the British Museum, which he most kindly gave me, in the following words:—"The highest monumental date known of Psammetichus I. is fifty-four years, according to the Apis Tablets of Serapeium, which agrees with the statement of Herodotus" [as to the length of his reign.] "The date of 664 B.C. is the lowest probable date of the accession of Psammetichus, which might be a year or two higher, and Boeckh's date is inadmissible." Dr. Birch, therefore, agrees with Sir J. Gardner Wilkinson, who dates it 664 to 611.

succession at the Pythian games for singing to the Kithara,[a] and that he sang his own epic verses as well as those of Homer.[b] Plutarch further adds that both Olympus and Terpander had tried a varied style of recitation, but had found it distasteful to, and strongly opposed by, the Greek public, and had therefore relinquished it. Also, that Olympus and Terpander limited themselves to one musical mode, or key, and to *three* strings,[c] although they well knew how to use a larger number. He commends them on that account, and says that their chanting far surpassed that of all others who employed a larger number of strings, and frequent changes of key, or mode.[d] So the singing by which Terpander gained public prizes was not his seven-stringed system, but a thoroughly Homeric kind of chanting, like that commended in the Odyssey. Some readers may have heard Italian *improvvisatores*, who recite their poems at a singing pitch of voice, without any tune, not even a chant, in the musical sense. Their manner of recitation is perhaps something of the Homeric kind. The Greeks gave the name of "rhapsodizing" to this manner of reciting epic poetry. Some, only, of the ῥhapsodists chanted in musical intervals.

Although Archilochus is often ranked as the cotemporary of Terpander, there was a wide musical step

[a] Plutarch *De Mus.* cap. 4.

[b] Plutarch *De Mus.* cap. 3.

[c] Plutarch *De Mus.* cap. 18. Herr Volkmann, who edited Teubner's edition of Plutarch, has altered the Homeric *τρίχορδα* of the text into *ὀλιγόχορδα*. He admits, in a note at the *end* of his book, that he has no authority for the change. It was most likely suggested to him by a guess of Burette's; but Burette admitted having but an imperfect knowledge of Greek music, and his guesses should not have been allowed to disturb the text of a classical author.

[d] Plutarch *De Mus.* cap. 18.

between them, if Archilochus played his accompaniments on the lyre under the voice-part instead of in unison with it. According to Glaucus's *Account of Ancient Poets and Musicians,* quoted and approved by Plutarch, Terpander preceded Archilochus, and upon that theory only is the account of his having played under the voice probable.

FIRST GREEK TUNING OF THE SEVEN-STRINGED LYRE.[a]

Upper Tetrachord.	d.	NETE (shortest string.)
	c.	PARANETE (beside the shortest.)
	b ♭.	PARAMESE (next to middle,) *or* TRITE (third.)
	a.	MESE (middle.)
Lower Tetrachord.	G.	LICHANOS (forefinger string.)
	F.	PARHYPATE (beside the longest.)
	E.	HYPATE (longest string.)

The Greeks had no names of any kind to distinguish musical notes.[b] They were expressed only by the titles given to the strings of the lyre, so that the note to be represented by any string would depend upon the pitch and tuning of the key-note of the lyre. For us it is more convenient to mark the intervals by the names of modern notes, as above, than to employ the constant repetition of "This was a tone distant," "That a semitone." But that the Greek are names of strings and not of notes, will remove a

[a] In this and in all the following *scales,* capital letters are and will be used to denote the base Octave, from A in the first, or lowest space, to G in the fourth space of that Octave; then small letters for the tenor "a" and all within its Octave; and lastly, italics for the treble *a* up to its *g* above. Thus, the capital letters A to G mean within the base staff. The small letter, or tenor "a," begins upon the fifth line of the bass clef, and ends with "g" on the second line of the treble clef. The italic, or treble, *a* begins on the second space of the treble clef and runs up to *g* in the space above the treble clef.

[b] When committed to paper the notation was *σημασία*—(Gaudentius, p. 20)—and the notes *σημεῖα.*

long-felt difficulty in the language as to the words *Nete* and *Hypate*, which have seemed to vary from their original senses when applied to music. Although *Hypate* is the lowest string in point of pitch and sound, it is the "highest" in the Greek sense, which is as to length. *Nete*, on the contrary, is highest as to sound, but is "lowest" when compared in length with any other. It is upon this ground that Nicomachus tells us that the gravest, or lowest, *sound* was ascribed to Saturn from his slow movement, and being furthest from us; "for," says he, "*Hypate* is the *highest*";[a] also, that *Nete*, the string of quickest movement and shortest length, producing the highest sound, was ascribed to the Moon, "which is the *lowest* of the planets and nearest to the earth."[b] Again, the longest string on the lyre was called the first, and the shortest was last.[c] As modern associations are connected with the pitch of sounds rather than with the length of the strings that produce them, we shall henceforth speak of *Hypate* as the *lowest* string, meaning that it gives the lowest sound, and of *Nete* as the highest, meaning that it gives the highest note.

The middle string, or *Mese*, was the key-note, and therefore the principal. Nicomachus compares it to the sun, as being the centre of the musical system, just as the other is of the planetary.[d] The two were

[a] "Ὁ βαρύτατος ἐν τῇ διὰ πασῶν φθόγγος ὑπάτη ἐκλήθη, ὕπατον γὰρ τὸ ἀνώτατον, . . νέατον τὸ κατώτατον."—(Nicomachus p. 6.) Boethius also says of *Hypate*, "eaque Saturno est adtributa propter tarditatem motus, et gravitatem soni."—(*Inst. Mus.* i. 20.)

[b] The seven planets of the ancients were Saturn, Jupiter, Mars, the Sun, Venus, Mercury, and the Moon.

[c] "τὸ γὰρ πρῶτον ὕπατον ἐκάλουν οἱ παλαιοὶ," and again, "νέατον γὰρ ἐκάλουν τὸ ἔσχατον οἱ παλαιοί."—(Arist. Quint. pp. 10, 11.)

[d] "καθάπερ καὶ ὁ ἥλιος ἐν τοῖς ἑπτὰ πλάνησιν ἑκατέρωθέν ἐστὶ τέταρτος, μεσαίτατος ὤν."—(Nicomachus p. 7.)

considered to make the consonance of a Fourth with their extremes on either side; for while the one passed over two planets, the other passed over two notes, as from "a" down to E, or up to "d." Nicomachus was a Pythagorean, and the Pythagorean doctrine, derived from Babylon and Egypt, was that the sun was the centre of the planets.

If we try this ancient seven-stringed system by a strictly musical standard, it will indeed be a poor one; but we must take it for what it was—a series of notes arranged for rhapsodizing,[a] before melody, of the modern kind, was born in Greece. The scale formed by two tetrachords joined together may have answered for the recitation of an epic poem, and for the expression of thoughts of an elevated character, but it was unequal to express the stronger emotions of the mind, such as are called into action by lyric poetry. The effect of such recitation upon us would be, musically speaking, one of continued sing-song, because the chant would sound to us as unfinished, and stopping, rather than ending, upon the third of the key, instead of upon the key-note. The reason for this is, that we can only associate such a series of sounds as E, F, G, A, B flat, C, D, with our major scale of F, which includes the B flat. Near as the Greeks seem to have been to finding out the

[a] Greek rhapsodizing was generally of epic poetry, and might be with or without accompaniment. In Boeckh's *Corpus Inscriptionum Græcarum*, vol. ii. p. 202, is a copy of an inscribed stone found at Chios, which commemorates, among others, the victors in the musical contests. The subjects were four, *ἀναγνώσεως*, *ῥαψῳδίας*, *ψαλμοῦ*, *κιθαρισμοῦ*, or first, reading musical notes; second, rhapsodizing; third, accompanying the voice on a stringed instrument of the harp kind, with the fingers of both hands; and, fourth, accompanying it on the Kithara, with hand and plectrum. The lower strings of the Kithara were played by the fingers of the left hand, and the higher strings by the plectrum held in the right hand.

major scale when they chose this succession of notes, yet their law that the Seventh of the scale must be a whole tone (at least) below the Octave, prevented their having, or at least acknowledging, the major key ever in a perfect form. Many pleasing melodies have been constructed by the moderns within the same compass, by taking the notes as in a major key, and making F the key-note; but with A for *Mese*, and with Greek musical laws, it was impossible to do much. The two extremes, E and D, were dissonant when sounded together, and the singer, or reciter, could neither rise a Fifth nor fall a Fifth from the key-note. The best that could be accomplished with such a scale will be judged by the Greek hymns in the following pages. In the meantime, we turn to Thoth, the Egyptian Hermes, and to his lyre.

CHAPTER III.

The Egyptian Hermes and his three-stringed "lyre."—The Chaldæan Octave-system same as the Egyptian.—The instrument of Hermes of the lute kind.—How long-necked instruments taught the mathematical proportions of the Octave.—Greek technical terms sometimes better than ours.—Egypt opened to the Greeks, and the advantages gained.—Fable of Terpander taking his lyre to Egypt.—Greek scales the same in number as Egyptian, and equally associated with the heavenly bodies.—Egyptian priests, and their Octave accompaniments.—Egyptian Magadis and tetrachord flute.—One Greek song same as an Egyptian.—The Egyptian nefer or lute is the hieroglyphic for "good."—The certainty as to the practice of harmony in ancient Egypt.—Egyptian ladies' amusements.—A private band.—More of Egypt.

THE following is the popular myth[a] of the invention of the lyre by the Egyptian Hermes, or Thoth:—"The Nile, after having overflowed the whole country of Egypt, when it returned within its natural bounds, left on the shore a great number of dead animals, of various kinds, and, among the rest, a tortoise, the flesh of which being dried and wasted by the sun, nothing was left within the shell but nerves and cartilages, and these being braced and contracted

[a] Dr. Burney, as well as Forkel, and others, who copy from Burney, refer this story to Apollodorus. But Apollodorus tells only the Mount Kyllene fable, of the Greek Hermes with the land tortoise (iii. 10), and not of the Egyptian Hermes on the banks of the Nile. Burney's account looks much like an embellished version of that of Diodorus Siculus. I have found no earlier authority for it than Servius, the grammarian and critic of the 5th century, who, in his commentary on Virgil's *Georgics*, lib. iv., says:—"Cum regrediens Nilus in suos meatus varia in terra relinquisset animalia, relicta etiam testudo est, quæ, cum putrefacta esset, et nervi ejus remanissent extenti intra corium, percussa a Mercurio sonitum dedit; ex cujus imitatione cithara composita est." Lucian and others adopt the Nile version of the story, but more briefly.

by desiccation, were rendered sonorous. Hermes, in walking along the banks of the Nile, happening to strike his foot against the shell of this tortoise, was so pleased with the sound it produced, that it suggested to him the first idea of a lyre, which he afterwards constructed in the form of a tortoise, and strung it with the dried sinews of dead animals."—(Burney's *History*, i. 200.)

Diodorus Siculus says nothing about the Nile, but that, when the Egyptian Hermes invented the lyre, "he gave it three strings, in allusion to the three seasons of the Egyptian year; for these three strings producing three different sounds, the acute, the grave, and the mean, the acute sound answered to summer, the grave to the stormy, or wintry season, and the mean (*μέσον*) to spring [and autumn]."[a] The Egyptians made but three divisions of the year, each of four months; "Euripides," says Plutarch, "rightly made four divisions, counting spring and autumn as each of two months, and summer and winter as each of four months." Any string made of the intestines of animals will tighten in damp weather, and so give a higher sound than when quite dry. Egypt had very little rain, but evaporations after floods drew up moisture from the earth. This

[a] "*Λύραν τὲ εὑρεῖν, ἥν ποιῆσαι τρίχορδον, μιμησαμένον τὰς κατ' ἐνιαυτὸν ὥρας. τρεῖς γὰρ αὐτὸν ὑποστήσασθαι φθόγγους, ὀξὺν καὶ βαρὺν καί μέσον· ὀξὺν μὲν ἀπὸ τοῦ θέρους, βαρὺν δὲ ἀπὸ τοῦ χειμῶνος, μέσον δὲ ἀπὸ τοῦ ἔαρος.*"—(*Hist.*, i. 16.) There is a little difference in Claudius Ptolemy's quotation from Diodorus Siculus, in the Vatican manuscript, p. 176, as given by Dr. Franz of Berlin. It is there only that "and autumn" is added after spring ("*ἔαρος καὶ τοῦ φθινοπώρου*"). The two short seasons are thus coupled together. Ptolemy says: "*φησὶν ὁ Διόδωρος ὁ Σικελιώτης ὅτι ὁ Αἰγύπτιος Ἑρμῆς πρῶτος λύραν ἐποίησε τρίχορδον, μιμησάμενος τὰς κατ' ἐνιαυτὸν τρεῖς κράσεις τῶν ὡρῶν, τήν τὲ θερμοτάτη καὶ ψυχροτάτην καὶ τὴν εὔκρατον. τρεῖς οὖν ὑπεστήσατο φθόγγους ὀξὺν καὶ βαρὺν καὶ μέσον,* &c." (p. 10, Franz.)

association of sounds with seasons[a] was, therefore, a natural one, and was not confined to Egypt. Plutarch tells us, in his commentary on Plato's *Timæus, or, De Animæ Procreatione,* that the Chaldæans, or native philosophers of the Babylonian empire, (who, according to Strabo, had a residence set apart for them in Babylon,[b]) connected sounds with the seasons in the following order:—that spring bore the proportion of a *Diatessarōn,* or musical Fourth, to autumn; that of a *Diapente,* or Fifth, to winter; and that of a *Diapasōn,* or Octave, to summer.[c] This quotation is useful in showing that the Chaldæans, or learned Babylonians, had the Diapason, or Octave system, like the Egyptians. The musical instruments of the people would also sufficiently prove it.

Boethius, who wrote between five and six centuries after Diodorus, says that the lyre of Mercury had four strings, the two extremes being an Octave apart, and the two interior ones sounding the Fourth and Fifth to the exterior, such as E, A, B, E, in ascending. But the three strings mentioned by Diodorus suffice to give those intervals, for the string that is a Fifth from one extreme of the Octave is at the interval of a Fourth from the other.

And now as to the Egyptian musical instrument which the Greeks included under the name of lyre.

[a] The rise of the Nile begins in July, and is at its height about the end of September. It declines visibly in the middle of October. Sowing time is at the end of November. Green crops last till February. Harvest in March. The Nile at its lowest in April.

[b] There was also a tribe of Chaldæans, who inhabited a far-away district of Babylonia, at a short distance from the Persian Gulf.

[c] "*Χαλδαῖοι δὲ λέγουσι, τὸ ἔαρ ἐν τῷ διὰ τεττάρων γίνεσθαι πρὸς τὸ μετόπωρον· ἐν δὲ τῷ διὰ πέντε πρὸς τὸν χειμῶνα· πρὸς δὲ τὸ θέρος ἐν τῷ διὰ πασῶν.*"—(Plutarch, vol. x., p. 261. Reiske's edit.)

Our learned and accurate countryman, Sir J. Gardner Wilkinson, says, in his *Popular Account of the Ancient Egyptians*, that "Besides harps and lyres, the Egyptians had a sort of *guitar*," (or rather lute,) "with three chords, which have been strangely supposed to correspond with the seasons of the Egyptian year; and here again Thoth or Mercury has received the credit of the invention; for the instrument having only three strings, and yet equalling the power of those of great compass,[a] was considered by the Egyptians worthy of the god, whose intervention on this and similar occasions is, in fact, only an allegorical mode of expressing the intellectual gifts communicated from the Divinity to man."

"The guitar consisted of two parts: a long flat neck or handle, and a hollow oval body, either wholly of wood, or covered with parchment, having the upper surface perforated with holes to allow the sound to escape. Over this body, and the whole length of the handle, were stretched three strings of catgut, secured at the upper extremity, either by the same number of pegs, or by passing through an aperture in the handle. . . . The length of the handle was from twice to thrice that of the body; and the whole instrument measured about four feet. . . . It was sometimes slung by a band round the neck, like the modern Spanish guitar, to which also it corresponded in being an accompaniment to the voice, though this did not prevent its being part of a band, as the other instruments. . . . The Egyptian guitar may be called a lute." (i. 123, et. seq.)

[a] This instrument is of itself of great compass, having two Octaves upon every string.

The second name, lute, is more appropriate, on account of the form of the back and sides of the instrument; because the lute was shaped like the half of a pear cut from the stalk, but the guitar has waving sides, which are at right angles with the front, and a flat back. The following are from Sir J. Gardner Wilkinson's work:—

Supported by a strap.

Dancing while playing the lute.

The Greeks had no musical instruments of any kind with necks until many ages after the Egyptians had employed them, and, even when possessing them, they continued to prefer their own, without necks, although they adopted the system of the Egyptians for the sub-division and measurement of strings. Yet herein lay the secret, why the ancient Egyptians, Assyrians, and Babylonians, had learnt the Octave scale system, which is the only true one, before the Greeks were even a nation.

Every instrument with an open back, like the Greek lyre, and like a harp without pedals, can yield

but one sound from one string; but if the same string be pressed against a finger-board fixed upon the neck of the instrument, it will give a complete scale of sounds. The first lesson to be acquired from it is, that exactly half of the string will sound the note that we call the Octave above that which is produced by the whole length. The only condition is that the string shall be of equal thickness throughout. Next, that by stopping a quarter of the string, the remainder will sound a Fourth above the whole; and that by stopping a third part, we obtain the interval called a Fifth, above the whole.

These three sounds were the foundation of the ancient Octave scales, and remain the same to this day. The only difference between ancient and modern science has been in the proportions of the two tones and semitone, for the filling up of the Fourth. Of these lesser divisions hereafter.

As the Egyptian lutes had very long finger-boards, according with the length of the necks, the eye could not, in a moment, determine accurately the point at which the half, the third, or the fourth part of a string ended; so they measured off those distances, and tied pieces of camel-gut round the neck to serve as guides for the finger. Some of the instruments discovered in the tombs had those divisions remaining. They are distinctly marked in the painting from which the frontispiece of this volume has been copied. Technically, they are called "frets," from their fretting, or rubbing, against the strings, when pressed down upon them.

The painting of the Egyptian ladies, who hold these lutes and the double pipe, is of the 18th dynasty of Egypt. It formed part of the plastered

wall of a tomb at Thebes, and both plaster and painting were safely brought to England, and subsequently were presented to the British Museum by Sir Henry Ellis. Some Egyptologists would date them as about the time of "the king who knew not Joseph"; others, perhaps, at a somewhat earlier period. If the ladies of Lower Egypt dressed their hair and adorned themselves in the bewitching style of these charmers of Thebes, we may the more admire the power of resistance in Joseph. Still, the ladies' feet are not quite Chinese as to size. Their lutes are adorned with ivory tail-pieces, and they are pictured as touching unrepresented strings with a plectrum. Its use was to save their tender fingers. The plectrum was generally attached to a piece of cord hung round the neck of the player, but sometimes it was tied to the tail-piece of the instrument.

Of the two ladies on the right, one is sounding a pair of pipes, which have ivory mouthpieces, and the other holds a sort of tambourine, which is neither round nor rectangular. The corners are parallel, but the sides and ends have an indented curve, to make the form more pleasing to the eye. There are several examples of this instrument in Sir J. Gardner Wilkinson's work. The lady seems to be tapping the tambourine with her fingers to mark time, but the plaster has unfortunately been broken away at that point, and the picture is not quite perfect.[a]

The measurements that were necessarily taken for fixing the frets upon Egyptian lutes, were the obvious clue to the discovery of the relation between

[a] This picture, which is perhaps now engraved for the first time, will be seen in the Egyptian Room in the British Museum, on the wall on the right hand from the entrance.

sounds and mathematical proportions. The Theorems in Euclid's *Sections of a String* (*Sectio Canonis*) are for the purpose of proving the best ways of subdividing strings by measurement upon a rule placed under them. Then, by calculating the proportions that one bore to another, to form laws for concord and musical scales. All the science of Pythagoras was founded upon such proportions.

The Greek names express musical intervals better than ours. What we call a Fourth they named a *Diatessarōn* ("right through four"). A Fourth has but three sounds, unless we include in it the starting note, instead of, according to the usual calculation, by counting from it. Thus, from C to F is called a Fourth, but F is only two tones and a semitone distant from C; for D and E are tones, and from E to F the semitone. So with the Fifth—the Greek name is *Diapente*, ("through five,") but unless the starting note be included, it consists of but three tones and a semitone, as from C to G.

Aristotle tells us that the Octave was called *Diapasōn*, ("through all,") instead of *di' octo*, ("through eight,") because, when the Octave was discovered, lyres had only seven strings.[a] (This is another of many proofs of the true date of the introduction of the Octave system among the Greeks.) For the same reason, the earliest name of the Fifth was *Dioxia* (*di' oxeia*, or *di' oxeian*,[b]) meaning "through the acute" strings of the lyre, because the deficiency of the one string was in the upper part of the instrument. The Fourth had its full complement of strings, and was first called *Syllabē*, (*sullabē*),

[a] Prob. xxxii. of Sect. 19.

[b] Philolaos, p. 66, edit. Boeckh, and Nicomachus, p. 17, edit. Meibom.

probably from "the lyre-like form of the fingers upon the four strings;"[a] for the lower four were intended to be played by the thumb and three fingers, and not by the plectrum, as will be shown later.

The fruits of the elementary knowledge thus acquired by the Greeks were soon after shown in the improvement of their music. It is not too much to say that they had not till then any music, in our sense of the word. Before the reign of Psammetichus I. Egypt had been a country very little known to the Greeks. No foreigner had been permitted to settle, or to penetrate into the interior. All were regarded with the same jealousy that the Chinese exhibit in our own days. But Psammetichus encouraged Greek settlers; gave his own children a Greek education; cultivated the friendship of the Greek nation, and engaged Ionian and Carian mercenaries in his army. He also committed Egyptian children to the charge of the mercenaries, to be taught the Greek language, and so to become interpreters between the two nations. It is to the ancient civilization, thus first fully thrown open to the Greeks, that we must attribute the sudden and rapidly-increased advances they made, within the two or three following centuries, not only in music, but also in other branches of science and art. The policy of Psammetichus I. was followed by his successors, especially by Amasis, and thirsters after learning of every kind flocked to Egypt, to become the teachers

[a] Porphyry says that Ælian, the Platonist, gave another derivation, but this was the one assigned by players on the lyre. It adds to the proof that the four strings, from *Mese* downwards, were played by the left hand, and not by the plectrum. — (Porphyry's *Comment. on Claud. Ptolemy*, edit. Wallis iii. 271.)

of their countrymen on their return. Thales and Solon were among the remarkable early visitors. It was there Thales learnt to divide the year into 365 days,[a] and to measure the height of pyramids "by the length of their shadow,"[b] perhaps with the help of an optical instrument for measuring heights, to which the Greeks gave the name of *Dioptra*—otherwise we must suppose that the Egyptians taught our Rule of Three. There Solon copied some of the best laws for his code. Pythagoras, who learnt the use of the *Dioptra*,[c] is said to have passed twenty or more years in Egypt and Babylon. That he must have been there, is sufficiently proved by his doctrines. It is also asserted by Iamblichus, Strabo, and others, supported by Egyptian authority; for Diodorus Siculus[d] says that the visit of Pythagoras to Egypt was registered by the Egyptian priests in their books. A tradition is recorded by Strabo[e] that Plato spent thirteen years of study at Heliopolis. Long after the subjugation of the country, Egypt remained the great seat of learning for the Greeks. The Alexandrian library was first formed to collect the wisdom of Egypt.

The fable of Terpander's having carried the lyre of Hermes into Egypt is told by Nicomachus.

[a] Into twelve months of thirty days, adding five days to each year, and a sixth day in every fourth year, our leap year, for the extra quarter of a day in every year. The priests of Heliopolis and Thebes, says Strabo, divided the year by the sun, and not by the moon, as the Greeks did. It was from the Egyptian priests that Julius Cæsar learnt the division of the year.

[b] "Ὁ δὲ Ἱερώνυμος καὶ ἐκμετρῆσαί φησὶν αὐτὸν τὰς πυραμίδας, ἐκ τῆς σκιᾶς παρατηρήσαντα ὅτε ἡμῖν ἰσομεγέθεις εἰσί." (Diog. Laert. i. 6, Paris, 1850, 8vo.)

[c] Nicomachus, p. 10, ed. Meibom.

[d] Diodorus Siculus i. 96.

[e] Strabo lib. xvii. 29.

According to him, Hermes gave his lyre to Orpheus, and instructed him in its use. After Orpheus had taught Thamyris and Linus, (the latter of whom taught Hercules and Amphion,) Orpheus, mortally wounded by the women of Thrace, threw his famous lyre into the sea. Thence it was afterwards discovered by fishermen, who took it to Terpander, and Terpander took this exquisitely-worked instrument to the Egyptian priests, and declared himsel, to have been the inventor.[a]

We are in no need here of the caution given by Herodotus, not to trust to Greeks who claimed to have taught the Egyptians, because, said he, Egypt had copied nothing from Greece.[b] There is a sufficiently fatal objection to the Terpander lyre-story, in the fact that the Egyptians had the same musical instrument, and with seventeen strings instead of seven, nine hundred years before Terpander's supposed visit;[c] and that they had also a musical scale of, at least, two Octaves at a still more remote period of history. The long neck of the Egyptian instrument proves the extent of the scale. If only one Octave of notes had been required upon one string, a neck, equal in length to the body of the instrument, would have sufficed; because half the length of any string of uniform thickness must produce the Octave above the whole length. But the neck is "from two to three times the length of the body," and that inconvenient extension for the arm

[a] Nicomachus, lib. ii., p. 29, ed. Meibom.

[b] Herodotus ii. 49, 123.

[c] "Harps of 14, and lyres of 17 strings, are found to have been used by the ordinary Egyptian musicians, at the remote period of the reign of Amosis, the first king of the 18th dynasty"—*i.e.*, before the birth of Moses.—Wilkinson's *Egyptians* ii. 273.

can only have been made for the sake of having two Octaves, or more, upon a string. If the half length of a string will produce one Octave, the halving of the remainder must produce a second Octave above the first. So the especial reason for a neck of evidently inconvenient length to be reached, was that there might be sufficient length of string to admit of space between the notes in the higher Octave, for the fingers to move there with equal freedom. If three-quarters of the entire length of the sounding part of the string, at that remote period, were made available for the touch of the fingers upon the neck of the instrument, it was certainly so made for the purpose of having a scale of two Octaves upon every string. Lastly, if one of those long-necked instruments had two or three strings, it was for the purpose of being able to sound two or three notes together; since the full compass of two Octaves of notes might be had in succession upon one string.

Nicomachus, quoting Pythagoras and Plato, tells us that the Egyptians ascribed twenty-eight sounds to the universe, calling it "twenty-eight sounding."[a] So the Egyptians must have had twenty-eight sounds, *i.e.*, twenty-eight notes, in their scales. That is the precise total number of Greek notes, in their greater and lesser perfect systems combined, and including all their scales—Diatonic, Chromatic, and Enharmonic. Neither in Egypt nor in Greece was there an actual limit to twenty-eight sounds, because all scales were transposable, but only twenty-eight notes could be defined, starting from any given pitch. Euclid, Nicomachus, Aristides

[a] "*ὀκτωκαιεικοσόφθογγος λεγομένη κατὰ τὸν Αἰγυπτίων προσηγορίαν.*"—Nicomachus, lib. ii., p. 38. (See also p. 36, ed. Meibom.)

Quintilianus,[a] and others, enumerate the Greek scales and their notes, and all authors are agreed as to the number being precisely twenty-eight. This most remarkable coincidence between Egypt and Greece seems nevertheless to have escaped the observation of historians of music. If it stood alone, it would almost suffice to prove the origin of Greek music. The number is too peculiar to have been arrived at by accident, within a compass of only two Octaves.

The names of the twenty-eight notes will be given hereafter in the scales. It may suffice now to say, that in the two-octave scales there were, as we have, fifteen notes for the Diatonic scale, and that there were four variable notes for the Chromatic scale, (one in each tetrachord,) and again four for Enharmonic. Then there was a fifth tetrachord for the Conjunct or Lesser Perfect System, which added only three notes to the Diatonic scale, because the lowest note was Mese, belonging to the old series. Add one variable note for Chromatic and one for Enharmonic in this tetrachord, and we have twenty-eight in all.

The Greeks were by no means prone to give too much credit to other nations, yet they did not assert any claim to the Chromatic scale, which, according to Plutarch, was well known to be of greater antiquity than the Enharmonic; but Plutarch says that Olympus was the inventor of an ancient kind of "Enharmonic." An analysis of Plutarch's description proves that the "invention" of Olympus consisted in the omission of one string out of the four in every tetrachord of the already existing Diatonic scale. No use was made by him of the quarter-tone

[a] Euclid, *Int. Harm.*, pp. 5, 6; Quint., pp. 9, 10. Nicomachus, pp. 39, 40; Arist.

which distinguished the true Enharmonic. The scale of Olympus was called by Euclid, and by other writers before Plutarch, the Common Genus, because those notes were included in all the genera. Olympus omitted the Fourth and Seventh of the Greek minor scale, and did nothing more.

The Greeks copied the Egyptians in associating musical sounds with the heavenly bodies; but, as they made their computations of time by the lunar month, they connected the twenty-eight notes of the scales with the twenty-eight days of the moon; and the fifteen notes of the Diatonic scale were the fifteen days of the moon's increase.[a] The Egyptians subdivided the lunar month into weeks through dedicating the first hour[b] of each of the seven days to the seven planets, as the seven deities, who were supposed to watch over them. This association seems to have originated in Babylon.[c] The seven planets and the seven days coincided with the seven notes of their Octave. If the scale of nature had been followed there would have been eight sounds in the Octave instead of seven. That is a noteworthy peculiarity, even in our present system.

One more link between the music of Egypt and of ancient Greece has been hitherto unobserved, through the misunderstanding of the musical technicalities

[a] Aristides Quintilianus, lib. iii., p. 136.

[b] Ὥρα is explained by Liddell and Scott as "any limited time or period fixed by natural laws and revolutions, whether of the year, month, or day." The meaning of "hour" is of comparatively late Greek date. In the note from Claudius Ptolemy, quoting from Diodorus Siculus, (*ante* p. 40,) ὧραι are applied to the seasons of the year. See also the note here below, where the twelve hours are *μέρεα*.

[c] Herodotus says that the Greeks learnt the use of the gnomon, of the sun-dial, and the division of the day into twelve *parts*, (*μέρεα*), from the Babylonians. (Euterpe, 109.)

in a passage from an early Greek author, and especially the word *anti*, which, when taken in the sense of *contra* or *loco*, made the parallel in the context unintelligible. It is in the treatise on elocution, (*Peri Hermēneias,*) which has been published under the name of Demetrius Phalereus, but which Ducange[a] unhesitatingly ascribes to Dionysius of Halicarnassus. This Dionysius is recorded as a writer on music by Porphyry.

"In Egypt," says the author, "the priests hymn the gods through the seven notes of the scale, sounding them in regular succession; and, being accompanied by the pipe and by the Kithara, [playing in Octaves] the resounding of these notes is heard with a very euphonious effect; whereas, he who omits the accompaniment of a musical instrument with his voice, takes away nothing less than the due modulation and the fitting tone from the passage."[b]

[a] "Testatur Dionysius Halicarnassus, lib. Περὶ Ἑρμηνείας, qui vulgo Demetrio Phalereo ascribitur." Ducange Gloss. Med. Latin. iv. 1219, sub voce "Nota."

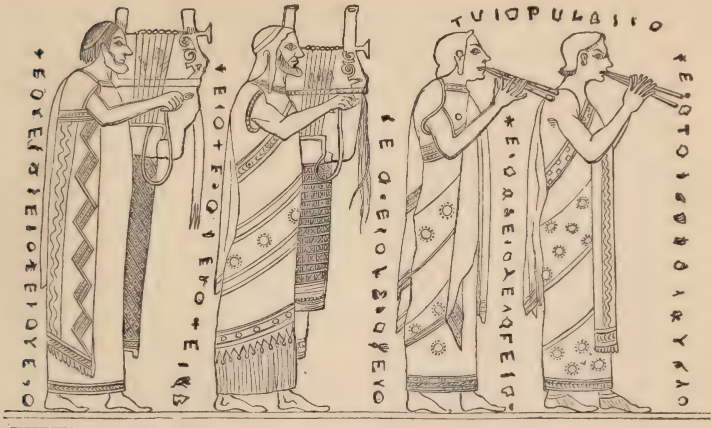
[b] "Ἐν Αἰγύπτῳ δὲ καὶ τοὺς θεοὺς ὑμνοῦσι διὰ τῶν ἑπτὰ φωνηέντων οἱ ἱερεῖς, ἐφεξῆς ἠχοῦντες αὐτά· καὶ ἀντὶ αὐλοῦ, καὶ ἀντὶ κιθάρας, τῶν γραμμάτων τούτων ὁ ἦχος ἀκούεται ὑπ᾽ εὐφωνίας· ὥστε ὁ ἐξαίρων τὴν σύγκρουσιν, οὐδὲν ἄλλο ἢ μέλος ἀτεχνῶς ἐξαίρει τοῦ λόγου καὶ μοῦσαν." (71. *De Elocutione*, 8vo. 1743, Glasgow.) There have been several puzzles to translators in the above. First, "*καὶ ἀντὶ αὐλοῦ καὶ ἀντὶ κιθάρας*," has been rendered by "*loco* tibiæ aut citharæ." The whole purport of the passage that follows is on the expediency of *having* the accompaniment of an instrument with the voice, and this would make it to be without one. It ought, therefore, to have proved such a translation to be wrong. Once more, *ἀντὶ* must be taken in the sense of "cum," or "accompanying." Again, *σύγκρουσιν* has been translated "concursum." The true meaning is "the accompaniment of an instrument." Thirdly, *ἑπτὰ φωνηέντων* is translated "the seven vowels." Having understood that there were not seven vowels in the Egyptian language, I referred to Dr. Birch, upon whose authority the number may be stated as "four with inflections." In that case, the *ἑπτὰ φωνηέντα* must be the *septem discrimina vocum*, (seven notes of the scale,) which the sense of the passage suggested. Nevertheless,

This practice of carolling or singing without words, like birds, to the gods, was copied by the Greeks, who seem to have carolled on four vowels, the Egyptians having but four.[a] The vowels had probably, in both cases, some recognised meaning attached to them, as substitutes for certain words of praise—as was the case when the custom was transferred to the Western Church. The E U O U A E, retained in the Roman Catholic service, is taken in the sense of "Seculorum, Amen," being the vowels of those words without the consonants. The Eastern Church also had its NOEANE, NONANOEANE, ANOAIS, &c. It has been supposed, by some, that the name of Jehovah, which in Hebrew consists of four letters, I H V H, originated in this manner of praise.

One of the Greek vases in the Museum at Berlin, No. 626, supplies such an exact Greek copy of this Egyptian custom, and so fully illustrates the preceding quotation, that it is here submitted to the reader. On the one side is a sacrifice to Athena, or Minerva, and on the other are four priests, playing on musical instruments, with the inscriptions before them. It is almost impossible to say with any certainty what all the letters are intended to be, on account of the carelessness of the execution; but, in the opinion of the late A. J. Vincent, of the Institut de France, they are intended for A, E, I, O. The first of the four is very like an X, and the whole supplies an excellent field for conjecture. It might have been expected that the Greeks would have *sol-faed* with their *tō, te, ta, tē*, if there had been no special reason for another selection.

the notes were most probably sung upon the open sounds of vowels.

[a] The probability of the use of but four vowels will appear from the inscription on the Greek vase which here illustrates the Greek custom.



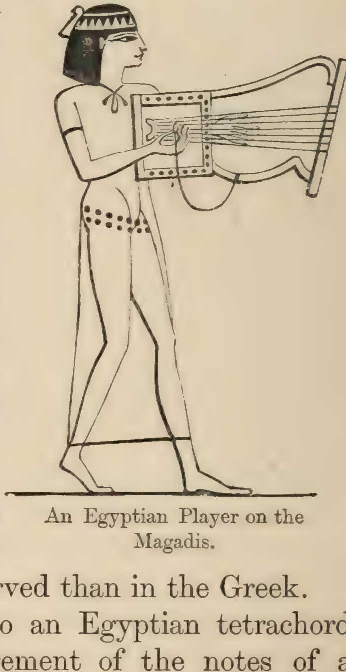
GREEK WORSHIP OF ATHENA, OR MINERVA.

It should be noted that the lyres in the above have each seven strings, according to the number of notes employed in this worship, as described by Dionysius Next, that the lyres have the double bridge, or "Magadis," across the strings, to divide each into two parts, so as to produce Octaves from the two ends. In ordinary lyres the thumb would be on the middle string, and the plectrum playing the four nearest to the body, but that is here reversed. Thirdly, that the priests are playing the higher and longer ends of the strings with the fingers of the left hand, and the under and shorter parts with the plectrum (*plēktron*) which each holds in his right hand. The double pipes are in all probability sounding Octaves, as with the Egyptians, for the object of double pipes would necessarily be to produce two simultaneous sounds. The external appearance does not make one pipe look larger than the other, but the distance of the holes from the mouth, and the size of the bore of the tube, would

determine the pitch. The pipe on the left of a player was usually to sound the under part,[a] and had apertures further distant from the mouth.

Gerhard, in his description of the vase,[b] says that the whole representation is identical with one in the frieze of the Parthenon at Athens, but that the letters are there scarcely visible.

And now, having shown the Greek copy, we produce the hitherto unobserved Egyptian Magadis. According to Athenæus, (lib. iv. Sect. 80,) the Magadis was classed among foreign instruments by Aristoxenus, and it is clear from the early date of Egyptian representations, that it was not originally Greek.


An Egyptian Player on the Magadis.

In the Egyptian instrument the proportionate length of string to make the Octave is better preserved than in the Greek.

The next point is as to an Egyptian tetrachord or "four-stringed" arrangement of the notes of a scale. There is in the museum at Florence, said the late Fr. Jos. Fétis, the lower part of an Egyptian flute, No. 2688. This is part of a long

[a] "Et ut dextera tibia alia quam sinistra ita ut tamen sit quodammodo conjuncta, quod est altera ejus carminis modorum incentiva, altera succentiva. Succinit tibia sinistra quod est inferior a dexteræ foraminibus." (Varro *De Re rustica*, 1, 2, 15.)

[b] *Etruskische und Campanische Vasenbilder des Königlichen Museums zu Berlin*, by Edouard Gerhard, Berlin, 1843, fol.

one, and about three-quarters of a yard (69 centimètres) long. A Florentine gentleman took the measurement of all the parts for Fétis, who engaged a flute-maker of Brussels to reproduce the ancient part in facsimile, and to add a head-piece from designs upon Egyptian monuments. All the minor details of this experiment may be passed over[a]—the one noticeable part is that between the highest and the lowest note, the interval was a Fourth; and that, as there were five holes, the pipe must have produced six sounds within this Fourth, or tetrachord, including the open note of the instrument. That is the precise number in a Greek tetrachord, when it includes the Enharmonic quarter-tone and the Chromatic semitone for change into those genera. So that this Egyptian model appears to have been the one upon which the Greek was formed.

[a] Either the dimensions between the holes had not been taken with sufficient precision, or what is equally probable, the flute maker had been improving upon his model. He would know nothing of quarter-tones, limmas, and discordant thirds, called Ditones, unless informed before hand, and would suppose the dimensions given to him to be inexact. The new flute turned out on the modern Chromatic scale; and Fétis, not being well-versed in ancient music, although he had written so much about it, did not perceive (to use the mildest phrase) the utter improbability of such a scale, but announced it as a discovery that he had made in his new *Histoire Générale de la Musique*, 1869, 8vo, vi. p. 223, 224. Another equally curious deficiency in Fétis was his lack of knowing the first laws of musical sounds, and telling of this flute, as a "phénomène unique en son genre;" that after the first harmonic of Octaves, that might be played above the natural scale on any flute, it produced Fifths! and he expected the double Octaves to follow, without the interposition of Fifths. The gradual increase of rapidity in breathing must necessarily produce Fifths after and above the first Octave in every flute—the Fifth being the second harmonic. This subject will be more fully explained further on. The worst part is to tell—M. Fétis, having made his experiments upon the restoration of the flute the basis of his theories upon ancient Egyptian music, has throughout treated Egyptian music as if it had been upon the *modern* Chromatic scale. See his *History* i. 324, et seq.

It does not follow that all Egyptian pipes, or all Greek, were made to include those two peculiar scales, which were comparatively but little used. Athenæus says that Pronomus, the Theban, was the first who played the three kinds of music upon one flute, (lib. xiv. cap. 31); and that before him players had separate instruments for each. We may suppose the same to have been the case with the Egyptians, for we find their pipes or flutes to have had three, and sometimes four holes, which could only have been for one or two kinds of scale, where the extreme sounds were but at the interval of a Fourth.

In addition to many intermediate links with foreign countries, such as the visits of Asiatics, and of men from the Isles, to Greece, there were several direct connexions between Egypt and Greece in more ancient times. In 1556, B.C., Cecrops is said to have led a colony from Sais, in Egypt, and to have founded the kingdom of Athens. Neith, or Nēt, was the deity of Sais; and her name seems to have led both to the name of the city and of the Greek goddess, Athena, or Minerva. Plato remarks upon the asserted identity of the goddess under the Greek and Egyptian names in his *Timæus.*[a] "In Egyptian," says Sir J. Gardner Wilkinson, "the name was written from right to left (ΘΗΝ,) and by adding an "A" at each end, the Greeks would make it Athena, reading from left to right."[b] It is well known that the Greeks adopted the gods of other nations, and their manner of worship, especially those of Egypt.

[a] *Timæus*, 21, e. [b] Wilkinson's *Ancient Egyptians*, i. 47.

The Greek vase has already exemplified this in the case of Athena.[a]

Again, Danaus, who seems to have been a brother of Amunoph III.,[b] is also said to have left Egypt and to have founded Argos, of which he became king, and died, B.C., 1425. It is probable that the colonies were formed chiefly by the military class of Egypt, and, therefore, brought no large amount of learning with them. The higher order of priests seem to have been too well provided for, to have been easily tempted to migrate.

There are other links to connect Egypt with Dorians,[c] Colchians, and others, and much in the mythology, to which space will not permit me to refer ; but one of the strongest proofs to a musical reader is the identity of a Greek and of an Egyptian song. When Herodotus visited Egypt, he was struck by nothing more than by hearing what he had thought to be a famous song of Greek origin, but which he then learnt was a most ancient Egyptian one—a mourning dirge for the premature death of the only son of Menes, the first king of Upper and Lower Egypt, and that it had been sung universally in Egypt from time immemorial. The Greek song was a lament for Linus ; and the name of the Egyptian song was a lament for Maneros.[d] Identity of song argues identity of system of music. There could be no such identity between a boat-song of the

[a] Herodotus says: "And, indeed, the names of almost all the Gods came from Egypt into Greece. . . . For, with the exception of Neptune and the Dioscuri, Juno, Vesta, Themis, the Graces, and the Nereids, the names of all the others have always existed among the Egyptians, (cap. 50.) Also that the Grecians received the above-named deities from the Pelasgians."

[b] Wilkinson's *Ancient Egyptians*, i. 57.

[c] See Herodotus *Erato*, 53 to 60.

[d] Herodotus, ii. 79.

Nile and any European air now. The tonal systems differ, so that no European can sing or write down the Arab's boat-song correctly in our music. There are numerous allusions to ancient Egyptian music in Greek writers, and a few to Babylonian, but not one among them has yet been found in which any comment upon difference of systems between Egypt, Babylon, and Greece, is to be traced. As Herodotus adds that the song of Linus was sung in Phœnicia, in Cyprus, and elsewhere, though with different words, we may assume that the identity of musical system extended there also.

Diodorus Siculus says that the musicians and poets of Greece visited Egypt for the purpose of improvement, and that the Egyptian priests had records of their visits in their books. The first two names so recorded were those of Orpheus and Musæus, and Homer followed. So, at least, the Egyptians claimed to have taught music and poetry to the Greeks at a very early period. The later names in Diodorus's list, such as those of Solon, Plato, and others, are admittedly authentic.

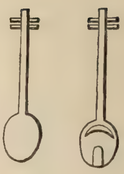
And lastly, as to the antiquity of the Egyptian Octave system. Not only have we drawings of the long-necked Egyptian lute in the eighteenth dynasty of Egypt, but we find it depicted even in the fourth dynasty, in the reign of Chephren, or Suphis II., second king, sometimes misnamed Sensuphis,[a] who erected the second great pyramid.[b] Egyptologists differ in estimating these remote dates, so I

[a] Bunsen has explained the error of the Greek scribe, as to *Sen*suphis, is his *Aegyptens Stelle*, iii. Append. p. 64.

[b] See, for instance, Richard Lepsius's *Denkmäler*, Dyn. 4. Abt. 2. Blatt 2.

leave the reader to select the authority he prefers from the note.[a] It is sufficient to say that, at the time of the building of the Pyramids, this musical instrument, which is one of a very advanced kind, was employed as the hieroglyphic for "good," and that the Egyptians were then in such a stage of civilization as to have other hieroglyphics of the papyrus book, the Egyptian writing materials, and inkstand, together with sculptures on the largest scale. The paintings of this long-necked Egyptian lute are sometimes accompanied by the name of the instrument, but giving only the consonants "n f r," and leaving the vowels to be supplied. Some interpreters have chosen "Nofre," one of the three Coptic dialectal names. Bunsen has a plural termination, "Nefru"; others "Nefr"; but, according to Dr. Birch, "Nefer" is now the name more generally adopted. The consonants "r" and "l" are interchangeable in Coptic, as in Hebrew, and hence, perhaps, the Hebrew *Nebel*, and the Greek *Nabla*.

[a] Lepsius dates the reign of the first king of the 4th dynasty of Egypt at 3124, B.C., and the reign of this second king as beginning in 3095 (of the Julian Era,) B.C. Sir J. G. Wilkinson says, "according to Manetho, the Pyramids were erected about 2120, B.C." The chronology which he himself adopts (that of Josephus) is that the reign of the builder of the first pyramid began 2123 B.C., of the second pyramid, 2083, B.C., and of the third pyramid, 2043, B.C. According to Bunsen, Wilkinson has quoted the pseudo-Manetho, and not the true one. When Egyptologists arrive at the 18th dynasty of Egypt there are no longer such grand discrepancies between them. The reign of the first king of the 18th dynasty, (supposed to be the "king who knew not Joseph,") is dated by Lepsius, 1591, of the Julian era, B.C., and by Wilkinson, 1575, B.C. According to Archbishop Usher, Abraham went to Egypt 1920, B.C., and according to the Rev. Dr. Hales's chronology, in 2077, B.C. Manetho, the Egyptian historian, described the 113 generations of the 30 dynasties of Egypt, *i.e.*, from Menes, first king of Upper and Lower Egypt, to the conquest by Alexander the Great—as comprised in a period of 3555 years. That is quoted from him by Syncellus, in his chronology. See Bunsen i. 98.



The following is the hieroglyphic. The two or four pegs across the head indicate that the instrument had then either two or four strings. As a hieroglyphic, it is more frequently found with one cross-bar. The second example here given shows the tail-piece to which the strings were attached, and the bridge over which they passed. The bridge is represented flat, but must have stood upon its two points. These are copied from Lepsius's great work, and are of the fourth dynasty of Egypt.[a]

When the French *savants* visited Egypt in the time of Napoleon I., the clue to hieroglyphics had not been discovered, and, according to them, a lyre of three strings, "to represent the constellation Lyra," was found in a little Egyptian temple, above the great temple of Denderah.[b] "It is of the same kind," says the writer, "as Diodorus Siculus speaks of in his *History*, lib. i., of which each string responded to one of the seasons of the year."

The Babylonian and Assyrian sculptures show the Nefer, as well as the Egyptian, but more sparingly; also the double pipe. In Wilkinson's *Manners and Customs of the Ancient Egyptians* (ii., 123), and in his *Popular Account* of them (i., 7,) the hieroglyphic will be found, with one bar across the neck of the instrument, over the doorway of a house, and the interpretation, "The Good Abode," or "The Good House." Any visitor to the antiquities of the British Museum will find numerous examples around him, and few will escape having their attention arrested

[a] The first hieroglyphic is from Lepsius's *Denkmäler*, Dyn. 4, Abt. 2, Blatt 40, and the second Blatt 29.

[b] Description de l'Egypte, 8vo, vi., 424.

A Song and Dance to the God Ptah, or Vulcan—18th dynasty—Thebes.

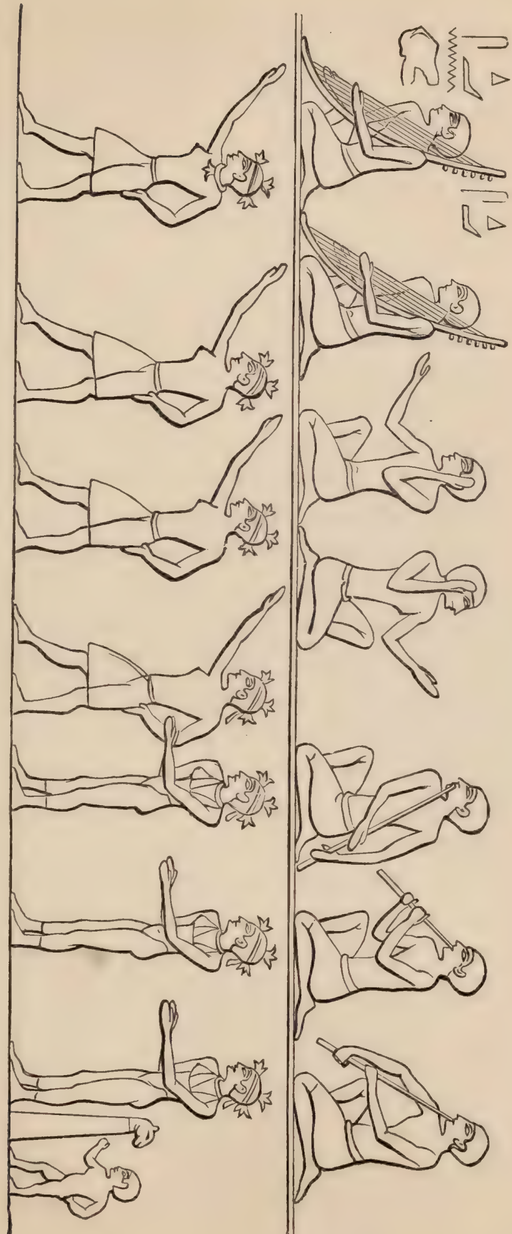
This is in the British Museum. From the hieroglyphs above, it appears to be vocal—a kind of hymn or song to the God Ptah, or Vulcan.—(S.B.)

by the magnificent sarcophagus of the daughter of Psammetichus II., and of Queen Nitocris, among the inscriptions upon which the hieroglyphic will be frequently seen.

The preceding painting of four ladies seated, and two female dancers, is also from Thebes, and of the eighteenth dynasty. Three hieroglyphic lutes will be found over the head of the third lady, who is singing and marking time with her hands. The fourth damsel, who is nearest to the dancers, is playing the tune for them upon two pipes, of the flageolet kind, and those pipes have ivory mouth-pieces. The painting is upon plaster that has been safely removed from the wall of a tomb, and is now in the British Museum.

But a still more curious scene is that of the private band and the singers of an Egyptian gentleman in the exceedingly early fourth dynasty. The lute, the papyrus book, and the writing materials are not the only marvels of that country, so wonderfully civilized, even at the period of the earliest cotemporary monuments in the world. An engraving, of the same kind as the following, was taken from the Pyramids of Memphis, and will be found in the *Description de l'Egypte,* published by the French Government, (vol. v., plate 17.) The Memphis band consists of but one harp, one side-blown flute, together with two pipes, or flutes, blown at the end, and two conductors beating time. The following is of Upper Egypt, from the Pyramids of Gizeh.[a] It is copied from Lepsius's splendid work, where it is included among other remarkable specimens of the fourth dynasty.

[a] Lepsius's *Denkmäler,* Abt. 2, Blatt 36. From the Pyramids of Gizeh, Grab 93.



The Instrumental and Vocal establishment of an Egyptian gentleman of the 4th dynasty.

We have here the private musical establishment, instrumental and vocal, of an Egyptian gentleman, named Tebhen, who was master of the tomb. In the large plate of Lepsius he is seated, with the *flagellum* in his hand, which is the sign of lordship and dominion. The upper two rows in the picture exhibit the wealth of the deceased; but the octavo size of this page admits only the lower two rows, which comprise his domestic musicians and singers. The hieroglyphics state his distinctions and his name. For the interpretation of the inscription I am indebted to Dr. Birch, for no letterpress has yet been published with Lepsius's *Denkmäler*. The painting exhibits two harpers with a conductor; one flute and two pipe players with another conductor; four male singers, with the right arm extended towards their patron, as if invoking him; and, behind them, three female singers, who also mark time with their hands. Lastly, a child, who taps upon some hollow bronze instrument that has an animal's head, and which could only be useful for beating time.

This re-duplication of time-keeping, together with the certain harmony which is being produced from the pipes, prove the advanced and the rhythmical character of this very early Egyptian music. It is not Homeric recitation, with license to ramble, but strictly metrical tune. There must have been a great falling off in the music when it first descended from the Egyptians to the Greeks, just as a similar decline took place when Greek music, in its advanced stage, first descended to the Western Church.

The great point to be established by Tebhen's band is the exceedingly early practice of instrumental harmony. The flute and pipes cannot be playing in

unison, on account of their varied lengths. Moreover the longest is being sounded in its lowest notes; but they may be playing the simplest form of harmony in Octaves, just as the men and women, if singing the same tune together, will make Octaves. We may indeed conjecture that more advanced harmony must have been produced from the three pipes, but we have no sufficient proof.

Sir J. Gardner Wilkinson enumerates thirteen different combinations of instruments that he has noted among the paintings of Egyptian bands, and he adds that there are many more. (*Pop. Acc.*, i. 86.) Besides these, are singers accompanied by harp, lyre, lute, by double pipes or flutes, and combinations of voice, lyre and lute, as well as of solo and chorus without any accompaniment. Some of the instrumental combinations are of four or five different kinds of instruments playing together.

The Egyptian flute, which was blown at the side, and very close to the end, was called the *Seba* or *Sebi.* It is the *Photinx* and the *Plagiaulos* of the Greeks, and the *Tibia obliqua* of the Romans. The Egyptian pipe blown at the end is the *Mam.* The precise Greek and Latin names of the last would depend upon whether that pipe was blown through a reed mouth-piece, or without one. If it had no reed mouth-piece, being a single pipe, it would be the *Monaulos.* But I shall describe pipes and flutes more particularly hereafter.

The harps varied much as to the number of strings. The upper part of one, in the British Museum, is made for seventeen strings; one in the Paris collection for twenty-one; and Wilkinson mentions one with twenty-five pegs—therefore for twenty-five

strings. We read of other harps which had thirty-five, and forty strings; the first, called by the Greeks the *Simikion*, and the second, the *Epigoneion.*

The Egyptian harps that had no poles or pillars to support the tension of the strings, could only have been tuned for low notes. Any such tension as that of modern harps would have pulled the frames to pieces. They had one kind of harp that would have supported much tension, and to that the Greeks gave the name of *Trigōn.*

We may trace the prototype of every Greek instrument in Egypt. No kind of advance upon that ancient country seems to have been made till the three Alexandrian mathematicians, Eratosthenes, Didymus, and Claudius Ptolemy, appeared successively upon the scene, and improved the scale. Eratosthenes, the first of them, was born about 276 B.C. He was Director of the Alexandrian Library.

The *terra firma* of Egyptian history seems to begin with Menes, the founder of the Empire of Upper and Lower Egypt. We have a cotemporary monument of the second dynasty in the Ashmolean Museum at Oxford. It is from the tomb of King Sent, and we there find a fine specimen of architecture, and the papyrus roll, or book, is among the hieroglyphics. "The Pyramids are the tombs of kings of the Old Empire," says Bunsen.[a] "The royal names discovered in them are all those of Eratosthenes. The number even of the great Pyramids accords with that of the kings in Eratosthenes."

"According to Diodorus and Plutarch, the shrine

[a] *Egypt's Place in History*, introduction to vol. ii.

at Memphis contained an inscription commemorating the imprecation of the father of the unfortunate Bocchoris against the aforesaid Menes, for having introduced luxurious habits into Egypt, the inconvenience of which he had felt severely in his Arabian campaign."[a] We know nothing of the infancy of Egypt. We find it only, from our first point of view, as a country of high civilization, with writing, with musical instruments of an advanced kind, and with wonderful architecture. The Lake of Mœris and the Labyrinth are to be numbered among the works of the Old Empire, as well as the Pyramids. "By the list of Eratosthenes," says Bunsen, "we obtain a connected chronology of the Old Empire of 1076 years." "The third king of the 13th dynasty lost Memphis and his throne by the irruption of the Shepherds. The holy city of the Empire [Memphis] was not re-conquered and restored till the 18th dynasty. One of its later kings entirely freed the frontiers from the occupation of the Hyksos."—(i. 80.)

"Egyptian history subdivides itself into three comprehensive periods—the Old Empire of Menes, (12 dynasties)—the Middle Empire, during which Egypt was tributary to the Hyksos, who reigned in Memphis (13th to 18th dynasty)—and the New Empire, from the 18th dynasty, which expelled the Hyksos, downwards. This threefold division is established by the monuments, even by those of the 18th dynasty alone; also by the authority of Manetho." The Hyksos, according to Manetho, were united North Arabian and South Palestinian races.

[a] Bunsen, ii. 52, quoting "Diodor., i. 45," and adding, "Confer Plut. de Is. et Os., cap. 8, and Athenæus, x. 4."

"The Egyptian laws and religion forbade change and improvement, while everything around them was changing as the centuries rolled on." Plato refers to their zealous adherence to antiquity in the following words:—"The plan we have been laying down for the education of youth was known long ago to the Egyptians—that nothing but beautiful forms and fine music should be permitted to enter into the assemblies of young people. Having settled what those forms, and what that music should be, they exhibited them in their temples; nor, was it allowable for painters, or other imitative artists, to innovate, or invent any forms different from those which were established, nor was it lawful, either in painting, statuary, or any branches of music," (ἐν μουσικῇ ξυμπάσῃ,) "to make any alteration. Upon examination, therefore, you will find the pictures and statues made ten thousand years ago are in no one particular better or worse than what they now make." (*Laws,* lib. ii. 64.)

The unchangeableness of hieroglyphics has been of the greatest assistance to modern inquirers; but, as to the ten thousand years, spoken of by Plato, we must take them *cum grano salis,* unless we should wish to chronologize the Egyptian gods.

CHAPTER IV.

The improved or Octave system of the Greeks.—Stories about Pythagoras.—The Monochord and the Pandura.—Egyptian ideas of Greek musical knowledge.—Three of the supposed discoveries of Pythagoras.—Earliest writings of the Pythagoreans.—The seven and the eight-stringed lyres.—How the lyre was held and played.—Eight strings sufficient for usual purposes.—The difference between a Greek one-octave and a two-octave scale, and the misunderstandings it has occasioned.—The Greek key note, and the importance attached to it.—How the literal translation of its name has led to misapprehension.—Difficulties in classical Greek writers explained.

And now, as to the ancient Octave system, which has been implicitly followed by the moderns, even in the present mathematical divisions of the scale.

Greek music did not attain so high a level for many centuries after the death of Pythagoras. The Greek scale adopted by the moderns was devised in the second century of the Christian era, and no further improvement has been effected since that date.

It is certain that Pythagoras did but import the Octave system from Egypt or Babylon, where it had existed for ages before his time, yet the vanity of certain Greeks, who were of a different stamp to Herodotus, led them to attribute the discovery to Pythagoras, because he was their countryman. To give circumstance and confirmation to this first fable, they concocted others as to the way in which he had been led to the discovery. These stories are such clumsy inventions, that they carry their own refutation.

The first is, that he was passing a blacksmith's shop, and, hearing the musical consonances of the Fourth, Fifth, and Octave, sounded by the various hammers on the anvils, he was induced to enter and to weigh the hammers. He is then said to have found the cause of the consonances in their respective weights, which were in the proportions of six, eight, nine, and twelve pounds. That of six pounds sounded the Octave to twelve; that of eight, compared with twelve, gave the interval of a Fifth; and those nine and twelve, sounded together, were at the interval of a Fourth. It is surprising how often this childish story has been repeated. Demolish it a thousand times and yet it appears again. In the middle ages such a discovery was thought too good for a heathen, and so Pythagoras was declared to be a misnomer for Jubal, and the real blacksmith to have been his brother, Tubal Cain. The first person who seems to have dared to express dissent from a story so generally adopted by the later Greeks was Claudius Ptolemy. He avoided the mention of Pythagoras by name, but cautiously hinted to them that the power of a blow increases loudness, yet does not alter the pitch of any sound, so as to make it higher or lower. (Lib. i. cap. 3.) Pythagoras should have looked to the anvils, for pitch, instead of to the hammers; as we should look to the bell instead of to its clapper.

The next story is that, pursuing his discovery, Pythagoras took four strings of equal size and length, and fixing them at one end, he passed them over such bridges as were used in musical instruments, (Magades,) and then hung weights to the other ends. He employed weights in the same proportions as the

hammers in the previous experiment, viz., of six, eight, nine, and twelve pounds; and it is said that he obtained the same results by those weights as with the hammers. Claudius Ptolemy, acting with his usual care not to give offence, only threw doubts upon this story, dissuading his countrymen from placing any reliance upon such an experiment. He did not emphatically deny its truth, but advised that they should trust only to measurement. For that purpose he recommended the *kanōn hármonikos,* consisting of a rule and movable bridges, to be placed under the strings. (Lib. i. cap. 8.)

So this fable went on uncontradicted, perhaps till the time of that great enquirer after truth, the astronomer Galileo. He seems to have been the first to point out that, to produce such results as Pythagoras was said to have obtained by *tension* upon equal-sized strings, the weights should have been the squares of those he is said to have employed; *i.e.*, instead of six pounds, he should have used six times six; and instead of eight, eight times eight, and so on.

The above stories are detailed by Nicomachus, (pp. 10, 11,) by Gaudentius, (p. 13,) by Boethius, and by a host of later writers.

If the third, and only possible account, had been left alone, it would have pointed too clearly to Egypt, or Babylon, as the source from which the knowledge of Pythagoras was derived. He is said, and probably with truth, to have next taken the measurement of the strings upon a stringed instrument with a rule and a movable bridge under them. Some said it was a Monochord, or one-stringed instrument, but if so, he could only have divided a string into two

parts, as in the Magadis. Nicomachus says that many called the supposed Monochord a Phandura—perhaps because they imagined the measurements to have been taken upon such an instrument—but that Pythagoreans entitled it a Kanōn.[a]

If Pythagoras experimented upon consonances, he should have had more than one string to work upon.

It may be noted that the Greeks had a three-stringed instrument called the Pandoura, or Pandura, which Julius Pollux enumerates after the Monochord, and says, "so called by the Assyrians, who invented it."[b] The name may have been derived from Assyria, and still the instrument, perhaps slightly varying in form, may have been common to Egypt under another title. Martianus Capella attributes the Pandoura to the latter country. His Nymph, while recounting the good she has done to mortals, says, "I have allowed the Egyptians to try their hands at the Pandura."[c] Among the Assyrian sculptures we find such an instrument, and it differs but little from the Egyptian Nefer, which may have been the Nabla of the Greeks. The Nabla and Pandoura are not strictly identical.

Athenæus, after quoting Protagorides of Cyzicus "On the Festivals of Daphne," as to "the bright sounding Pandoura,"[d] states that Pythagoras, who wrote a book about the Red Sea, says that the Trōglodytai, (who bordered upon it,) make the Pandoura out of the *daphne*, *i.e.*, laurel, that grows on the sea shore.[e] Thus the instrument is brought

[a] "*Τά τε μονόχορδα φαίνεσθαι, ἃ δὴ φανδούρους καλοῦσιν οἱ πολλοί, κανόνας δ' οἱ Πυθαγορικοὶ.*"—(Nicomachus, p. 8.)

[b] *Onomasticon*, lib. iv. cap. 9.

[c] "Panduram Ægyptios attemptare permisi."—(*De Nuptiis Philologiæ*, lib. ix.)

[d] "*Ὑπὸ φανοῦ πανδούρου.*"—(Lib. iv. 176 B.)

[e] Lib. iv. Sect. 82, pp. 183, 184.

within the knowledge of Pythagoras, and to the southern part of Egypt, or of Ethiopia. It may be added that, in and before the time of Claudius Ptolemy, three strings had been found insufficient for trying and measuring consonances, and that the Greeks then used an instrument to make many sections, called the Helikōn.[a] Movable bridges had the effect of fixing the sounds, as the hand pressing strings upon frets.

Aristides Quintilianus states that, when Pythagoras was upon his death-bed, he exhorted his friends to use the Monochord, "by which," says he, "Pythagoras shewed that the intervals in music are rather to be judged intellectually, through numbers, than sensibly, through the ear."—(p. 116.) Plutarch also attributes this doctrine to Pythagoras, (*De Musica*, cap. 37,) and it became the distinguishing principle of the Pythagorean musicians—"Sense is but an uncertain guide; numbers cannot fail."

We know the opinion of the Egyptians as to the small amount of the Greek knowledge of music before the visit of Pythagoras, from what one of the Egyptian priests said to Solon, in order to suggest an apology for it. Plato, too, seems to have accepted the Egyptian estimate of his countrymen's acquirements, by repeating the story. The priest accounted for the Greeks having no remote history, because they had but recently begun to commit their records to writing; and, as their country had been swept by a current from heaven, rushing on them like a pestilence, the survivors had been left destitute of literary attainments, *and unacquainted with music.* "And thus," said he, "you

[a] Ptolemy, lib. ii. cap. 2, and Arist. Quint., lib. iii. p. 117.

became young again, as at first, knowing nothing of the events of ancient times, either in our country or in your own." (*Timæus*, 23 B.) The Egyptians had no record of the great Deluge in their own land.

Pythagoras is supposed, according to the weight of authorities, to have been born about the year 570 B.C., and to have visited Egypt in the reign of Amasis, which was one of forty-four years, commencing from about the date of the supposed birth of Pythagoras. The discoveries attributed to Pythagoras are too various and too vast for any one mind to have originated, but they are not beyond what might have been learnt by one person, and carried away from a country of ancient civilisation. Among his reputed discoveries are the doctrines of the Immortality of the Soul, and the musical harmony in the revolutions of the heavenly bodies. The first is clearly referred to the Egyptians by Herodotus, who adds, that "some of the Greeks have adopted this opinion, (some earlier, others later,) as if it were their own; but, although I know their names, I do not mention them."—(ii. 123.)

The doctrine of the Harmony of the Spheres is referred to the Chaldeans by Philōn Judæus.[a] It was associated with astronomical reckonings, and with the Octave system of music.[b] It must, therefore, have followed the Octave system. The theory was based upon calculations of distances, and of the rapidity of motion, of the stars and planets, from observations which must have been made by a long line of astronomers. This doctrine was

[a] In his treatise "On the migration of Abraham," vi. cap. 32, p. 464; again, in cap. 33; and thirdly, in his treatise "On seeking Instruction," cap. 10.

[b] "*Τὸν ὅλον οὐρανὸν ἁρμονίαν φασὶν εἶναι καὶ ἀριθμὸν.*" — Aristot. *De Cœlo*, iii. 1.

adopted by Archytas, by Plato, and by all the philosophers, says Plutarch; "for the universe," say they, "was framed and constituted by its author on the principles of music."—(*De Musica*, cap. 44.)

The ancients accounted for those sounds not reaching mortal ears, as, sometimes owing to the magnitude of the concussions of the air, (τὸ μέγεθος τῶν ψόφων,) and, at others, as exceeding our powers of hearing, both in acumen on the one hand, and in gravity on the other.[a] Herein they anticipated philosophical discoveries of the last and of the present centuries, which prove, by resultant sounds, that some concussions of air could only produce sounds too high, and other experiments prove that sounds may also be too low, for our hearing.[b] Again, they argued that there are many sounds in nature of which we know nothing—some, on account of the feebleness of the concussion; others, on account of their great distance; and, again, others, on account of their excess being too great for our organs to endure. "Our ears," said Archytas, "are like narrow-necked phials, out of which, if it be attempted to pour rapidly, nothing will come."[c]

As to the Octave system of music, the earliest extant notice of it among the Greeks is included in some fragments of the writings of Philolaos, "the successor of Pythagoras," who is reputed to have been the first to publish the Pythagorean doctrines. The part concerning the Octave system of music, or *Harmonia*, supplies the old Pythagorean musical terms, which, not being generally known, are here

[a] Porphyrii *Commentarius*, p. 257, edit. Wallis.

[b] The experiments by which these facts have been established will be hereafter referred to under the Science of Music.

[c] Porphyrii *Comment. in Harmonica Claud. Ptolomæi*, apud Wallis, iii. 257.

printed, with their proportions as musical intervals. Some of the terms were afterwards rejected and others retained. A few have already been explained (pp. 35, 36, 46). Proportions will be more fully explained hereafter. The following is the passage :—

Ἁρμονίας δὲ μέγεθος ἐντὶ συλλαβὰ καὶ δι' ὀξειᾶν ·	The extent of the Octave system is a Fourth and a Fifth;
τὸ δὲ δι' ὀξειᾶν μεῖζον τᾶς συλλαβᾶς ἐπογδόῳ ·	but the Fifth is greater than the Fourth by a Tone; [proportion of 9 to 8.]
ἔστι γὰρ ἀπὸ ὑπάτας ἐς μέσαν συλλαβὰ,	for, from the lowest string to the middle string is a Fourth; [E to A]
ἀπὸ δὲ μέσας ποτὶ νεάταν δι' ὀξειᾶν,	but from middle to highest string a Fifth; [A to E]
ἀπὸ δὲ νεάτας ἐς τρίταν συλλαβὰ,	from the highest to third string [from the top] a Fourth; [E to B]
ἀπὸ δὲ τρίτας ἐς ὑπάταν δι' ὀξειᾶν ·	from the third to the lowest a Fifth; [B to E]
τὸ δ' ἐν μέσῳ μέσας καὶ τρίτας ἐπόγδοον ·	between the middle string and third is a Tone. [A to B].
ἁ δὲ συλλαβὰ ἐπίτριτον	The Fourth is in the proportion of 4 to 3;
τὸ δὲ δι' ὀξειᾶν ἡμιόλιον ·	the Fifth is in the proportion of 3 to 2;
τὸ διὰ πασᾶν δὲ διπλόον ·	the Octave in that of 2 to 1.
οὕτως ἁρμονία πέντε ἐπόγδοα καὶ δύο διέσιες,	Thus the Octave system is of five Tones and two Semitones;
δι' ὀζειᾶν δὲ τρί' ἐπόγδοα καὶ δίεσις,	the Fifth is of three Tones and a Semitone;
συλλαβὰ δὲ δὺ' ἐπόγδοα καὶ δίεσις.[a]	the Fourth of two Tones and a Semitone.

[a] Philolaos, edit. Boeckh, p. 66. This passage is also quoted in more modern Greek by Nicomachus.—(p. 17, edit. Meibom.)

These intervals will be found verified in the following scale for the seven-stringed lyre.

The first observation to be made upon the above is, that we have *diesis* here used for a semitone, like the modern French *dièse*; but *diesis* was afterwards transferred to the smaller interval of either a third part, or of a quarter, of a tone, in the Chromatic and Enharmonic scales; and this Diatonic semitone, or hemitone, was then called a *limma* or remnant (*λεῖμμα*) by the Pythagoreans, and hemitone only by the Aristoxenians. Next, the distinction is to be here observed between *Harmonia*, the Octave system of music,[a] and *Diapasōn*, the Octave itself. Plutarch tells us that Pythagoras limited the doctrines of Harmonia to the sounds that are included in the Diapason, or Octave.[b] That was the original definition, and one Octave suffices to exemplify every other. Philolaos defines Harmonia as "altogether composed of opposites, for it is the union of many ingredients, and the connection, in two ways, of varying, or different-meaning, parts."[c] The "two ways" (*διχᾶ alias διχῆ*) may be assumed to mean by Fourth and Fifth, and by Fifth and Fourth, whether up or down in the Octave, as defined in the preceding quotation from the same author.

The Octave system, new to the Greeks, was called

[a] "Τὸ *διὰ πασῶν* (*σύστημα*) *ἁρμονία* (*ἐκαλεῖτο*) *παρὰ τοῖς παλαιοῖς*."—Arist. Quint., p. 17, and at p. 91. See also Plutarch *De Musica*, cap. 23. Claudius Ptolemy only accords the name of perfect system, (*τέλειον*) to that of two Octaves, because compound intervals could not be calculated within one Octave.

[b] "Πυθαγόρας *δ' ὁ σεμνὸς .. τῇ δ' ἀναλογικῇ ἁρμονία · αὐταρκές τ' ἐνόμιζε μέχρι τοῦ διὰ πασῶν στῆσαι τὴν τῆς μουσικῆς ἐπίγνωσιν*."—(Plutarch *De Musica*, cap. 37.)

[c] "*Ἁρμονία δὲ πάντως ἐξ ἐναντίων γίνεται · ἔστι γὰρ ἁρμονία πολυμιγέων ἕνωσις καὶ διχᾶ φρονεόντων σύμφρασις*."—(Philolaos, edit. Boeckh, p. 61.)

"Harmonia," and this name seems not to have been derived from Harmonia, the wife of the Phœnician, or Egyptian, Cadmus, the reputed founder of Thebes, and teacher of the alphabet, for there is no apparent connection between her and music: it was more probably taken from the verb *harmozein*, "to fit together," because it "fitted in," and "dove-tailed" the only two lesser consonances of the Greeks, viz., the Fourth and the Fifth, within the greater consonance, the Octave. (The older system had no such fitting in.) The perfect participle of this verb was also used in music as an adjective, *hērmosmenos*, meaning "fitting according to the laws of music" or "musical." Pythagorean musicians took the name of *Harmonici*,[a] (although others called them *Canonici*, from their measurements by a rule,) and Aristoxenus charges some of them with having continued to teach the following seven-stringed system exclusively, and calling that Harmonia, long after lyres had been made to carry eight and even fifteen strings.[b] The charge of Aristoxenus against his predecessors, of having taught only the Enharmonic system, must be received with some qualification, for, against it, we have the above Diatonic system from Philolaos; we have it also in the *Timæus* of Plato; and Ptolemy has preserved the scales of Archytas in the three genera, in his lib. i. cap. 13.

The seven strings of the lyre were soon increased to eight. The manner in which that addition was made, will be best seen by placing the two systems side by side, as in the following:—

[a] "*Οἱ καλούμενοι ἁρμονικοί*," says Aristoxenus, with some contempt. —(p. 40, edit. Meibom.)

[b] "*Ἀλλὰ περὶ αὐτῶν μόνον τῶν ἑπταχόρδων, ἃ ἐκάλουν ἁρμονίας, τὴν ἐπίσκεψιν ἐποιοῦντο.*"—(p. 36, edit. Meibom.)

THE DISJUNCT, OR OCTAVE SYSTEM.

	SEVEN-STRINGED LYRE.		EIGHT-STRINGED LYRE.
	e. NETE.	Upper Tetrachord.	e. NETE.
	d. PARANETE.	Upper Tetrachord.	d. PARANETE.
		Upper Tetrachord.	c. TRITE.
	b. PARAMESE, or TRITE.	Upper Tetrachord.	b. PARAMESE.
Lower Tetrachord.	a. MESE. (Key Note.)	Lower Tetrachord.	a. MESE. (Key Note.)
Lower Tetrachord.	G. LICHANOS.	Lower Tetrachord.	G. LICHANOS.
Lower Tetrachord.	F. PARHYPATE.	Lower Tetrachord.	F. PARHYPATE.
Lower Tetrachord.	E. HYPATE.	Lower Tetrachord.	E. HYPATE.

The intermediate tone, or tone of disjunction, is, in both cases, immediately above the key note, *i.e.*, from "a" to "b ♮," instead of to "b ♭."

The notes which are here ascribed to the strings are taken from the Hypo-Dorian, which was the "Common" Greek scale, and is our "Natural" scale, or A minor, with a minor Seventh. Aristotle describes it as most suited to the Kithara, being "the most stately and stable."[a] It was no doubt the general scale, because it is within the natural compass of a man's voice.

Boeckh found a difficulty about the name of the third string from the top in the seven-stringed system, "b," from its being called *Paramese* by some, while Philolaos seems to call it *Trite.* But while Philolaos speaks of it as the "Third" (*Trite*) in numbering it from the highest string of the tetrachord, he also explains that it is at the interval of a Fourth from the highest, and of a Fifth from the lowest string; therefore, even if differing in name, there is no difference in meaning. Aristotle says that the *Trite* of the eight-stringed lyre was the omitted string.[b] It is very clear why this string ("c," in the above scale,)

[a] Prob. xlviii. of Sect. 19.

[b] See his Problems vii., xxxii., and xlvii. of Sect. 19.

was omitted in preference to any other. It made a minor Third from the key-note upwards, ("a" to "c,") and a major Third from the highest string downwards, ("e" to "c;") and Thirds, as they tuned them, were discords. The ancients wanted Fourths and Fifths in preference, because they were consonances. By the above arrangement there was, from the key note, "a," upwards, a Fourth, ("a" to "d;") and a Fifth, ("a" to "e;") and in coming down from "e," there was the choice of a Fourth to "b," or of a Fifth to "a." Again, "b" made a Fifth to the lower "e."

The improvement in this system over the preceding one was very great. The tone interposed between the two Fourths or tetrachords, made the compass an Octave, instead of a discordant minor Seventh. This tone was called "diazeutic," (*tonos diazeuktikos,*) or the "tone of disjunction," because it separated the two tetrachords. The scale then became like ours, in what is called "one" key, instead of turning out of the scale of A minor at the fifth ascending note, as it would if "b" flat had been retained, instead of "b" natural. So the upper tetrachord began one note higher in the Octave systems, viz., on "b" natural instead of "a."

Some lyres of large size were upon stands; but those of a portable character, like the Kithara, were held on the left side of the body, with the left arm behind the instrument, for the purpose of reaching the base strings, which were furthest from the player.[a] The left hand took the lower tetrachord, the thumb being on Mese, the key-note. The little finger was not used. The forefinger of the left hand

[a] "*Λύρα μὲν ἐν ἀριστερᾷ χρώμενον, πλήκτρῳ δὲ ἐν δεξιᾷ, πρᾶγμα οὐδέν.*"— Plato *De Legibus*, vii. 794.

gave the name of Lichanos to the string next below the key-note.[a] The right hand held the plectrum, and touched only the treble strings, which were nearest to the body of the player. The plectrum was of horn, ivory, bone, or of any hard wood.

The left arm had to contribute to the support of the lyre, but the right was more disengaged, and was sometimes flourished about, to assist in declamation, or held out as if addressing the audience. The principal duty fell upon the thumb of the left hand, because it was upon the key-note.

When the lyre had eight strings, the five from the key-note upwards completed the notes of the Fifth, and then its older name, *Dioxia,* gave way to that of *Diapente,* "through five." No change was made in the word *Diapasōn* (the Octave), because "through all" was as applicable to eight strings as to seven.

The strings of the lyre were usually counted from the lowest and longest, as No. 1, and the highest and shortest was the last. This is, at least, the way in which Nicomachus and Aristides Quintilianus count them.[b] Trite, for the third string from the top, seems to have been exceptional. It may have been because it was at the interval of a "Third," both from the key-note and from the highest string.

For all purposes of declamation, and for a simple chant, the Octave lyre was a sufficient instrument. The reciter could take his key-note at a comfortable pitch, so that he could sing a Fifth up, and a Fourth down, in his natural voice, without exertion. The

[a] "Ἀπὸ τοῦ τὸν τῆς ἀριστερᾶς χειρὸς δάκτυλον, τὸν παρὰ τὸν ἀντίχειρα, τὸν οὕτω λιχανὸν καλούμενον, αὐτῷ ἀεὶ ἐπιτίθεσθαι."—Nicomachus, p. 22. See also Arist. Quint., p. 10.

[b] See Nicomachus, p. 33, and Arist. Quint., p. 10.

compass was ample for such a purpose. This use of the lyre for recitation continued for ages after the time of Dionysius of Halicarnassus. Aristides Quintilianus also contended that orations, as well as poetry, lost much of their effect upon the hearers if unaccompanied by a musical instrument.[a]

It is essential to bear in mind the difference between this Greek one-octave vocal scale, and the Octave of modern times. By an Octave scale, we mean one that begins on the key-note, and ends on its Octave above or below; but a Greek single Octave began on the Fourth below the key-note, and ended on the Fifth above it. That was the better arrangement for singing, because the Greek had a few notes on each side of his key-note, and we have either all above, or all below. But when the Greeks extended their scale to two Octaves, their arrangement was the same as ours. They added a Fourth to the top, and a Fifth to the bottom of their one-octave scale.

It is surprising what a difficulty this slight variation of habit has occasioned to the moderns. All the supposed "inscrutability" of the Greek modes rests upon the misunderstanding of this simple point —the difference between a complete Greek scale of two Octaves, and a single Octave of the same. It is that difference only which made them an insolvable riddle to Sir John Hawkins, as well as to others, both before and after his time.

And now, as to this important key-note—important in all music, but especially so in Greek. It was always called Mese, whether it occupied the place of "middle" string, which the word means, or not. When the lyre had but seven strings, Mese was

[a] Arist. Quint., lib. 2, pp. 63, 64.

in the middle, but when the number was increased to eight, there could no longer be any middle string; for, as Aristotle says, in referring to it, "eight has no middle."[a] Still, it was the centre of every complete two-octave scale. If the Greeks would but have changed the name of their key-note to one less misleading, when they made their lyres of eight or ten strings, it can hardly be supposed that their system could have remained for so long a time a mystery to the moderns; or that the thorough identity of the Greek with our old minor scale should not have been perceived. The name, Mese, was retained because, although the number of strings might vary, the system of tuning the lyre to Mese made it ever the centre and turning point of the scale. When Bacchius asks, "What is change of system?" (*metabolē sustēmatikē*,) he gives the answer, "When we change from one system" [*i.e.* scale] "into another, making another string Mese."[b] Euclid says the same.[c] Aristides Quintilianus says that "systems without mutation are those with one key-note (Mese), and that mutable systems have several."[d] Euclid the same.[e] As there could not be several "middle strings" to a lyre, it must be evident that Mese has a second meaning. Change of system is change of scale. It would, indeed, include such a change as from Diatonic to Chromatic, but as that would not alter Mese, these writers can only mean change from one *key* to another—or, as the Greeks would call it, from one mode to another, as Dorian to

[a] Problems xxv. and xliv. of Sect. 19.

[b] Bacchius Senior, pp. 13, 14, edit. Meibom.

[c] Euclid, *Int. Har.*, p. 2.

[d] Arist. Quint., p. 17.

[e] Euclid, *Int. Har.*, p. 18.

Hypo-Dorian, or to Phrygian. Mese may or may not have been middle string, but, in Greek music, it had the *invariable* meaning of key-note. It was equally the pitch-note for reciting. "The name, Mese," says Aristotle, "was taken into the Octave system from the seven-stringed lyre."[a] Euclid says that all other notes are tuned to Mese.[b] Here again, it must be key-note. So also, Bacchius says, "Mese is the string from which, in the Octave lyre, the Fourth is tuned down, and the Fifth up, and from which the two-octave scale is tuned both down and up."[c] "Mese is the leader and sole ruler of the scale," says Aristotle.[d] "Why, though all the strings be in tune except Mese," says Aristotle again, "does the whole scale appear out of tune; and yet, if any other string be out of tune, that single string only is affected?" He answers that, "in all good poetical recitation or song, Mese" [the key-note] "must be constantly used, and that all good composers do so. When they quit it, they return to it quickly, but to no other in a similar way." He compares Mese to the conjunctions in language, and says that if we take away such as *te* and *kai*, it will no longer be Greek speech, but that words of another kind might be omitted from the language without such inconvenience, for the conjunctions are in constant requisition, while others are so but little in comparison with them. In the same way, says he, "Mese" [the key-note] "is the *conjunction* of sounds, and, especially of the sweet ones, because

[a] Problems xxv. and xliv. of Sect. 19.

[b] Euclid, *Int. Har.*, p. 19.

[c] Bacchius Senior, p. 16.

[d] "*μέση καὶ ἡγεμών*," in Prob. xxxiii., and "*τὸ μέσον μόνον ἀρχή τις ἐστιν*," and "*τὸ μέσον ἦν ἀρχὴ μόνον*," in Prob. xliv., both of Sect. 19. See also Problems xx. and xxxvi.

its sound exists in them."[a] Mese remains at this day the key-note of our minor scales, which were inherited from the Greeks, and not from the Western Church. The scales of the latter had not true key-notes.

Having quoted freely from Aristotle's Problems, it is perhaps here the place to refer to a supposed difficulty in Problems vii., viii., xii., and xiii. of Section 19, as to the lowest sound of the Octave being the antiphōn to the highest, rather than *vice versâ*, and as to the low sound absorbing the "*Melos*" of the high one. The lower sound of the Octave is the generator of the upper, which is its first harmonic; and as the upper vibrates as two to one of the lower, it is more quickly over. The difficulty has been only created by misunderstanding the word *Melos* to mean "melody," as if the lower took the *tune* away from the upper, but *Melos* means only a succession of sounds that vary in pitch, up and down, whether in speech or in music, and it is quite as applicable to any under part as to an upper. If we hear the voices of men and women singing together in a room, the more rapid vibrations of a woman's voice seem to give it superior power; but if a chorus of men's and women's voices be heard singing the same subject at a distance, especially in the open air, the women's voices will seem to give brilliancy to the men's, and to die away in them,[b] for the slower vibrations of the men's voices continue

[a] Prob. xx. of Sect. 19., edit. Bojesen. The 36th Problem in the same Section is to the like effect, though in other words: — "τὸ ἡρμόσθαι . . . . ἔχειν πως πρὸς τὴν μέσην."

[b] My learned friend, G. A. Macfarren, from whose conversations upon music I have gained so much of the information here made available, tells me that he has often noticed this effect.

after those of the women have ceased. The effect of the longer duration of sound in a low note than a high one, may be tested on a pianoforte by striking low and high together. The higher the note, the shorter will be its duration.

The above answer to the difficulty in Aristotle's Problems applies equally to the similar passages of Plutarch in his *Convivial Questions*, lib. ix., Quæst. 8, and in his *Conjugal Precepts*, cap. 11.[a]

Further examples may be desired, and having referred to *Melos* in Aristotle's Problems, and in Plutarch, as meaning only the undulations of succeeding sounds, it becomes expedient to show how wide were the senses in which the word was applied. Plato says that "*Melos* is compounded out of three things, out of speech, out of music, and out of rhythm;"[b] and Aristides Quintilianus says that *Melos* is indeed perfect when it combines speech, music, and rhythm, but that the more precise meaning of the word, as in music, is "the linking together of sounds that differ as to acuteness and gravity."[c] Bryennius includes the same words.[d] Aristoxenus opens his treatise by describing the different kinds of *Melos*, and, after that of music, he says:—"There is also some *Melos*, so called, in speech, which is compounded out of the accents that accompany it; for it is natural to raise

[a] "Ὥσπερ ἂν φθόγγοι δύο σύμφωνοι ληφθῶσι, τοῦ βαρυτέρου γίνεται τὸ μέλος," &c.

[b] "Μέλος ἐκ τριῶν ἐστι συγκείμενον, λόγου τὲ καὶ ἁρμονίας καὶ ῥυθμοῦ."—Plato, *Republic*, iii. 398 d.

[c] "Μέλος δὲ ἐστι τέλειον μὲν τὸ ἔκ τε ἁρμονίας, καὶ ῥυθμοῦ, καὶ λέξεως συνεστηκός· ἰδιαίτερον δὲ, ὥς ἐν ἁρμονικῇ, πλοκὴ φθόγγων ἀνομοίων ὀξύτητι καὶ βαρύτητι." — Arist. Quint., p. 28., edit. Meibom.

[d] "Μέλος τοίνυν ἐστὶ τέλειον μὲν τὸ ἔκ τε ἁρμονίας καὶ ῥυθμοῦ καὶ λέξεως συνεστηκός· ἤτοι ὀξύτητος καὶ βαρύτητος, ταχύτητος καὶ βραδύτητος, μακρότητος καὶ βραχύτητος· Ἰδιαίτερον δὲ ὥς ἐν ἁρμονικῇ, πλοκὴ φθόγγων ἀνομοίων ὀξύτητι καὶ βαρύτητι," &c.—Bryennius, p. 502.

and to lower the pitch of the voice in conversation."[a] Ezekiel ii. 10, which, in the Septuagint version, is "*thrēnos kai melos kai ouai*," is rendered in our English version "lamentations, and mourning, and woe." According to the Greek, it might have been translated "lamentation, and *wailing*, and woe," for Eastern mourning is intended, and implied in the word *Melos*. In the *Electra* of Euripides (l. 756), the rising and falling sound of the battle cry is *Melos boēs*. The *Melos* of rhythm, to which Plato refers, is, according to Aristides Quintilianus, "the rise and fall of the voice between the up and down beats, the *arsis* and the *thesis*,"[b] which together constituted a *pous*, or foot, in verse. When applied to musical instruments, *Melos* expresses the rise and fall of their sounds, while *Melōdia* applies only to those of the voice. To connect *Melos* or *Melōdia* with modern melody, so as to exclude recitation by unmusical intervals, required the addition of an adjective (such as *teleion*, or *hērmosmenon*), unless explained by the context. Our modern melody comes within the Greek definitions of *Melōdia* and *Melos*, but they are far from being its synonymes, because, in neither of the Greek words was it indispensable that there should have been music, in our sense of the word. In fact, if we require more precise definitions of *Melos*, we may turn to the instructions for making it, under the head of *Melopœia*, in the treatises on music, and we shall there find it

[a] "Λέγεται γὰρ δὴ καὶ λογῶδές τι μέλος, τὸ συγκείμενον ἐκ τῶν προσῳδιῶν τῶν ἐν τοῖς ὀνόμασιν· φυσικὸν γὰρ τὸ ἐπιτείνειν καὶ ἀνιέναι ἐν τῷ διαλέγεσθαι," (or "ἀνιέναι τὴν φωνὴν ἐν τῷ διαλέγεσθαι.")—Aristoxenus, p. 24, edit. Marquard; also quoted by Bryennius.

[b] "Ἐν δὲ μέλει, τοῖς λόγοις τῶν ἄρσεων πρὸς τὰς θέσεις."—Arist. Quint., p. 32, edit. Meibom.

explained as the rise and fall of the voice, either by gradual ascent and descent, or by any intervals up and down. These were to be varied by pauses, or by iteration of the same sound. It was *Melopœia* that brought out the force of elocution in tragedy.[a] Aristotle says that there are six necessities for tragedy—the most important being the language, and that, "of the remaining five, *Melopœia*," or due inflection of the voice, "is the greatest charm."[b] It is somewhat remarkable that all this should have been left unexplained by historians of music.

[a] "*Λέγω δὲ λέξιν μὲν αὐτὴν τὴν τῶν μέτρων σύνθεσιν· μελοποιΐαν δὲ, ὃ τὴν δύναμιν φανερὰν ἔχει πᾶσαν.*" —Aristotle's *De Poetica*, cap. 14, Tyrwhitt's edit. (1794), p. 19.

[b] "*Τῶν δὲ λοιπῶν πέντε, ἡ μελοποιΐα μέγιστον τῶν ἡδυσμάτων.*"—*Idem.*, cap. 15, Tyrwhitt's edit. (1794), p. 25.

CHAPTER V.

Greek figure of speech "adding a string to the lyre."—Ion's addition of a tetrachord to the earlier system.—The Lesser System Complete.—Former misconceptions about it.—The Greater System Complete.—The two systems quite distinct, but have been treated as one.—Greek Modes and their attributed characters.—No musical difference in them but pitch.—Principal modes for the voice.—Fifteen modes.—Greek modulations like ours.—Plutarch on Plato.—Harmony of the universe four Octaves and a Sixth.—Pythagorean system of the planets revolving round the sun.—The musical theory.—The doctrine of making the earth a fixed plain in the centre of the universe invented six centuries after the true Egyptian teaching of Pythagoras.

Whenever the Greeks wished to compliment an eminent poet-musician upon his having introduced some novelty in the style of his poetry and recitation, they chose to express it by the figure of speech, that "he had added a new string to the lyre." The phrase was happily selected to express that he had enlarged the powers of instrument and voice; but it was as purely figurative, as if we were now to say familiarly of a man who had made some useful discovery, that it would be "a feather in his cap." In later ages this mere idiom came to be appropriated by certain Greeks in a literal, instead of a figurative, sense, and hence the long and conflicting list of double and even triple claimants for every string to the lyre, such as that copied by Boethius, into his treatise upon music.

As to the addition of one or more strings to the Octave system, even if the scale had not been

borrowed entire, it would have required no genius to make such a discovery as, that, if one note had its Octave, another must have the same. The first Octave sound discovered was the clue to the whole series, as is sufficiently proved by the Magadis and the double flute, which are older by many ages than the Greek claimants for the added strings.

It was the same with the tetrachord system. One tetrachord having been joined on to another, nothing was easier than to add a third. In the time of Terpander the number of strings had thus been increased from four to seven, by the addition of an entire tetrachord; and in the time of Ion, of Chios, by another tetrachord, from seven to ten. There was no such gradual progress as seven, eight, nine, and ten strings. For these additions by tetrachords we have the best evidence, in the authors themselves, and it is by far the more probable mode of increase.

The Conjunct system never extended beyond eleven notes, and then the eleventh string was borrowed from the Octave system, and added on at the base of the scale, to make an Octave to the key note.[a]

When thus completed, the scale obtained the name of the Conjunct, or the Lesser System Complete,[b] and retained it until Claudius Ptolemy disallowed the claim of the Lesser System to be considered complete, because it did not include the consonances of Octave with Fifth, nor of the double Octave.

A "system," says Euclid, "is compounded of one or more intervals," (p. 1,) but Aristoxenus says, "a system is to be understood as something compounded

[a] Aristides Quintilianus, p. 10.

[b] "Καὶ ἔστι τὸ μὲν ἔλαττον (σύστημα τέλειον) κατὰ συναφήν." — Euclid, p. 17.

of more than one interval," (p. 15). In either case, a Fourth, (being compounded of two tones and a semitone,) and a Fifth, (of three tones and a semitone,) were systems, and hence the necessity of the addition "complete," (*teleion*) to signify an entire scale. Claudius Ptolemy differs from earlier writers in his definition of a complete system. He admits of nothing less than two Octaves, because any smaller compass cannot include the whole of the consonances.

According to Suidas, Ion, the cotemporary of Sophocles and of Pericles, produced his first tragedy in the 82nd Olympiad, (453 B.C.,) and was dead before the year 421, B.C.

The following lines, from a hymn by Ion, are quoted in Euclid's *Introduction to Music*, (p. 19,) where they follow immediately after the lines already cited from a hymn by Terpander (*ante* p. 30).

> ———" Having the ten-note scale,
> Combining threefold consonance:
> Till now with seven-string lyres the Greeks hymned thee,
> Upraising stinted song."[a]

From the above fragment of a hymn, and from that of Terpander, which is also part of a hymn, it would appear that the ancient scale of conjoined tetrachords was kept in use, and was perhaps, at that time, chiefly reserved for purposes of religion. It is difficult to find another reason for its vitality, after so very superior a system as that of the Octave had been discovered.

[a] ——" *Τὴν δεκαβάμονα τάξιν ἔχουσα*
Τὰς συμφωνούσας ἁρμονίας τριόδους,
Πρὶν μὲν σ' ἑπτάτονον ψάλλον διὰ τέσσαρα πάντες
Ἕλληνες, σπανίαν μοῦσαν ἀειράμενοι." —(Euclid, p. 19, edit. Meibom.)

The three consonances to which Ion refers can only be the three tetrachords conjoined. He could not intend the Octave system, because, instead of only three consonances from ten strings, there would have been five even from seven strings, viz., two Fourths, two Fifths, and an Octave, as already shown in the extract from Philolaos.

The new scale of Ion's was called *Episynaphē*, or Conjunction upon Conjunction.[a] Here, then, in Athens, two hundred years after Egypt had been opened to them, the Greeks had but just added the third conjunct tetrachord to their old defective scale, which was still maintained, at least for hymns, in the most polished city of Greece. Diodorus Siculus alludes to this conservative spirit of the Athenians, who, "being an Egyptian colony, had derived their institutions from the parent country,"[b] and Plutarch refers to the same as characteristic of the second Egyptian colony of Argos. "It is related," says he, "that the people of Argos prohibited by law any extension, or alteration, of their musical system, imposing a fine upon the first person who should venture to increase the number of strings of the lyre beyond seven."[c] That law was aimed at checking extravagances in recitation—it could not have been intended to limit music in the modern sense.

Of the like spirit as existing among the ancient Egyptians, in regard to their hymns to the gods, Plato says, that "such was the reputed antiquity and sanctity of some of the hymns, that they were ascribed to Isis, and were held to be ten thousand years old."

[a] "ἐπισυναφή."—Bacchius Senior, p. 21, edit. Meibom.

[b] Diodorus Siculus, i. 28.

[c] Plutarch *De Mus.*, cap. 37.

The additional tetrachord of Ion made a great musical improvement, because it supplied the lower D to the Octave in the Dorian scale, (our D minor, with a minor Seventh,) and thus the "b" flat in that scale was properly brought into play. When the eleventh note was added, (viz., the A at the base of the scale,) it equally completed an Octave of the Hypo-Dorian scale, (our A minor,) from base A to tenor "a," because the lower B in the scale was natural, as required for the key of A minor, although the upper "b" was flat, as required for D minor. How completely does this foreshadow, and tell the origin of the ecclesiastical scales of later days, with the lower B, natural, and the upper "b" flat!

THE CONJUNCT, OR LESSER SYSTEM COMPLETE.

σύστημα τέλειον κατὰ συναφὴν.[a]

The Conjunct, or Synēmmenōn Tetrachord.	d. Nete.	Synēmmenōn.
	c. Paranete.	,,
	b ♭, Trite.	,,
Middle, or Mesōn Tetrachord.	a. Mese.	
	G. Lichanos.	Mesōn.
	F. Parhypate.	,,
	E. Hypate.	,,
The Lowest, or Hypatōn Tetrachord, added by Ion, B.C. 450 to 420.	D. Lichanos.	Hypatōn.
	C. Parhypate.	,,
	B (♮). Hypate.	,,
The Added Tone, or Octave.	A. Proslambanomenos.	

[a] Nicomachus (p. 21) writes of the fourth and highest tetrachord as having been added to the Conjunct system before the Octave system had caused the interposition of a tone above the key note, and had added an Octave tone at the base. This would contradict Ion, and the Pythagoreans too. Considering the comparatively late date of Nicomachus, and that he could not tell where the interposed tone was

This scale, with the added tetrachord of Ion, is one of two scales that Meibom misunderstood,[a] and his account includes another error, which Dr. Burney too hastily adopted from him.[b]

The original seven strings had seven different names, but no additional names were given to the strings of the tetrachord added by Ion. It therefore became necessary to distinguish between the new and the old series by adding to the name of each string that of the tetrachord to which it belonged. So the name, *Hypate* (E), became lengthened into *Hypate Mesōn, i.e.*, of the middle tetrachord; and the newly added *Hypate* (B) was *Hypate Hypatōn, i.e.*, of the lowest tetrachord.

When A, the Octave below the key note, was added under Ion's tetrachord, the above scale became identical, as to this lower Octave, with the other scale upon the Octave system, viz., from base A to tenor

placed, whether "between Mese and Trite, or, as some say, between *Trite and Paranete*," (p. 21, l. vii., *ab imo*,) he is not, in this case, to be treated as an authority. Neither is Nicomachus a good authority for history. He tells the fables that were copied by Boethius.

[a] See Meibom's notes upon Euclid, p. 63, where he has made impossible tetrachords. Every Greek tetrachord in a Diatonic scale *must* have the semitone between the lowest two strings. He founded his version of the scale upon *Parhypate*, C, which is a movable sound; instead of upon the lowest note of the tetrachord, *Hypate Hypatōn*, (B); and next, he included both a *Paramese* and a *Trite* above. Whichever of the two names he might have chosen to adopt, they represented but one string (b flat) in the Conjunct system.

[b] Meibom was evidently under the disadvantage of not having read Sect. xix. of Aristotle's Problems. It is clear that the seven strings that had names, with Mese in the middle, must have been the original seven; but Burney, misled by Meibom, supposes them to have been from *Hypate Hypatōn* to *Mese*. So, according to them, *Mese* was not the "middle" of anything, but an extreme string; and Aristotle must have been wrong in his derivation of *Mese*. (See Burney's *History*, i. 278.) Burney had read the Problems, and yet he adopted this error from Meibom's note upon Aristides Quintilianus, at p. 209.

"a." The divergence of the two systems commenced from tenor "a." The preceding scale of eleven notes turned off to "b" flat, "c," and "d," and there stopped; while the larger scale, of fifteen notes or two complete Octaves, followed on its course with an upper Octave in the same key as the lower, viz., from tenor "a" to treble "*a*."

This will be seen by comparing it with the following:—

THE DISJUNCT, OR GREATER SYSTEM COMPLETE.

(σύστημα τελείον κατὰ διάζευξιν.)

The Extreme, or Hyperbolæōn Tetrachord (ὑπερβολαίων.)	*a*. Nete.	Hyperbolæōn.
	g. Paranete (*or* Diatonos).	,,
	f. Trite.	,,
The Disjunct, or Diezeugmenōn Tetrachord (διεζευγμένων.)	e. Nete.	Diezeugmenōn.
	d. Paranete (*or* Diatonos).	,,
	c. Trite.	,,
	b (♮). Paramese	,,
The Tone of Disjunction (τόνος διαζευκτικός.)		
The Middle, or Mesōn Tetrachord (μέσον.)	a. Mese. (Key Note.)	
	G. Lichanos (*or* Diatonos).	Mesōn.
	F. Parhypate.	,,
	E. Hypate.	,,
The Lowest, or Hypatōn Tetrachord (ὑπατῶν.)	D. Lichanos (*or* Diatonos).	Hypatōn.
	C. Parhypate.	,,
	B. Hypate.	,,
The Added Octave Tone (not belonging to any Tetrachord.)	A. Proslambanomenos.	

In the above scale a second name (Diatonos) has been added to the *Paranete* and to the *Lichanos*

strings, which occupy corresponding positions in the tetrachords. The first named are in tetrachords above the key-note, and the second in those below it. The additional name arose in this way. When the lyre was tuned for the Enharmonic, or for the Chromatic scale, the two inner strings of each tetrachord were altered in pitch, and so represented variable, or movable sounds, (*kinoúmenoi, keklinénoi,* or, *pherómenoi*). The outer strings of all tetrachords, and the Octave below Mese, were immovable (*akínētoi, ménontes,* or, *éstōtes.*[a]). The chief alteration was in the *Lichanos*, and its equivalent, the *Paranete* string of a tetrachord. They were changed in pitch for both Chromatic and Enharmonic scales. At first *Diatonos* was added to the name of *Lichanos*, when for the Diatonic scale; and afterwards, for brevity, it was sometimes called "*Diatonos*" only. In other cases it was called *Lichanos Enarmonios*, or *Lichanos Chromatikē*, according to which of the two the scale might be.

The reader of Dr. Burney's account of Greek music will not have discovered from it that there were two distinct systems of Greek music in use simultaneously, as here just exhibited. Burney regarded the two only as one "General System of the Ancients," and termed what are properly the third and fourth ascending tetrachords of the "Greater System," the "fourth and fifth." With him, the "b" flat tetrachord of the "Lesser System" was the third; and the fourth (as he termed it) was supposed to commence by a descent from the top of this third tetrachord, viz., from D to B ♮, and then to reascend. It is "something of the *dodging* kind," said he,

[a] Claud. Ptol., lib. i. cap. 12.

"that is to be found in the scale of Guido, divided into hexachords." (*History*, i. p. 5, note *f*.) The way he fell into this error was by copying Meibom's ready-made diagram in his notes upon Euclid, (p. 51), and, with it, the word "system" in the singular number. (Compare Burney, i. p. 22.)

And now, as to the Greek musical keys, or modes (*tropoi*). The principal three, for the voice, were Dorian, Phrygian, and Lydian. They had, for a long time, no settled pitch, even in relation to one another, for the names were first used in reference to the character of poetry to be recited, and not as to pitch. They denoted the general tenor of a composition, a certain style of poetry with its appropriate metre, and the spirit of a song.

The ancients were not agreed as to what were the characteristics of any of the modes except the Dorian, of which Plato says, that it was the only true Greek style. That was severe, firm, and manly. The Phrygian mode was reputed by some to be enthusiastic and orgiastic, deriving its character from the Phrygian style of worship. Aristotle, for instance, described it as enthusiastic and bacchic; but Plato, on the contrary, as smooth and fit for prayer. Again, the Lydian mode was esteemed by some as modest, decorous, and fit for boys; by others, as plaintive and erotic, (or fit for love songs); by others again as expressive of mournful affections.

The reason for these conflicting descriptions is to be found in the fact that "particular metres were appropriated to particular modes;"[a] and, unless all

[a] Plato's *Laws*, ii. 670.

poets could first have been induced to agree in the appropriation of one style of song to each particular metre, there could be no general agreement as to the character of the mode. A martial song and a hymn may now be written in the same metre and be played in the same key—there will be a wide difference in the character of the words of the two, and in the spirit of the music, but no change in the notes of the key, in which they may both be played. The notes of the key constitute the musical mode.

Boeckh has collected various estimates of the characters of the modes among the ancients;[a] but, musically speaking, the only difference was one of pitch, which, in itself, could confer no character, because all the Greek modes were tuned in the same way. Difference of character in modern keys of music arises solely from imperfection in tuning them, one scale being left less perfect, in order to improve another. We must, therefore, look exclusively to the metre of the poetry and to the spirit of the words, which the style of music would follow, for any attributed difference which has been marked between one Greek mode and another. Dorian gravity would be fitted by spondaic metre and common time, while the more lively strains would require more rapid feet, and some would be better fitted by triple time.

The relative pitch of the modes was long unsettled. Aristoxenus has noted some of the ancient vagaries, such as placing Dorian and Hypo-Dorian only a tone apart, and the Mixo-Lydian between them.[b]

[a] *Metres of Pindar*, lib. iii. cap. 8.

[b] Aristoxenus, lib. ii. p. 37; Meibom's edit.

Again, Athenæus[a] gives several quotations which show that Æolian, at an early date, held the position afterwards assigned to Hypo-Dorian—just as Mixo-Lydian was transferred, and became synonymous with Hyper-Dorian. This will explain a passage about a combination of Æolian and Dorian modes, quoted from Pindar by the Scholiast on *Pyth.*, ii. 127, and which has been a musical crux :—

"Αἰολεὺς ἔβαινε Δώριον κέλευθον ὑμνῶν."

So Pindar refers to the Greek Conjunct system, in which the "b" flat gave the option of the Dorian mode, joined on to the Hypo-Dorian, or natural scale. This modulation to the Fourth above was the usual hymnal one from the date of Terpander to that of Ion, and even down to existing specimens of Greek hymns, which will hereafter be presented to the reader, and for the first time, in an intelligible form. In the time of Plato, however, the modes seem to have acquired an established order of succession, and therewith obtained that secondary meaning of relative pitch, which is their more important feature in a strictly musical view of the subject. In the same way, the secondary meaning of Mese, as key-note, is far more important than the primary, for it has afforded a far greater insight into Greek music, than the mere fact that it was originally the middle string of the lyre.

Aristides Quintilianus, after saying that Dorian, Phrygian, and Lydian were the principal modes for the voice, adds that the others were rather for musical instruments.[b] Bacchius Senior puts the question: "If three modes only are sung, which

[a] Athenæus, lib. xiv. cap. 19, p. 624. [b] Arist. Quint., p. 25.

are they?" The answer is (inverting the usual order) "Lydian, Phrygian, and Dorian."—"And if seven?" Answer: "Mixo-Lydian, Lydian, Phrygian, and Dorian," and the *Hypos*, or Dominants, of the last three.[a] He numbers the vocal scales in order of descent, the Mixo-Lydian "g" being the highest. The modes were not always called *tropoi*, which carried with the name an implied character, or style, but sometimes only as *taxeis* or *syntagmata* (positions or arrangements of notes in musical scales,) as in preceding quotations, and by Aristotle.[b]

In the time of Aristoxenus, who was a pupil of Aristotle, there were thirteen Diatonic scales, viz., one for each of the twelve semitones of the Octave, and one for the Octave itself.[c] In the time of Alypius (said to be about 115 B.C.), the number had been increased to fifteen, by giving to each of the five principal scales its *Hypo* and its *Hyper*, the one beginning the Fourth below and the other a Fourth above.[d] Thus there were three scales beyond the compass of an Octave, and they were necessarily duplicates of others that were the same notes an Octave lower.

The following is the enumeration of the modes, according to Alypius, with their relative pitch. It is only necessary to remark that the Mixo-Lydian (not here included by name) is the same scale as the Hyper-Dorian, viz., "g," it being a Fourth above the Dorian. The letters prefixed refer to the lowest note of the scales, or the Octave below their Mese.

[a] Bacchius, p. 12, edit. Meibom.

[b] "Τὰ δ' ἄλλα συντάγματα τὰ μὲν Δώρια, τὰ δὲ Φρύγια καλοῦσιν."—Aristot. *Politic.*, iv. 3, 7.

[c] Euclid, p. 19.

[d] "Ὅπως γ' ἂν ἕκαστος βαρύτητά τε ἔχει, καὶ μεσότητα, καὶ ὀξύτητα."—Arist. Quint., p. 23.

DOMINANTS.	PRINCIPALS.	SUB-DOMINANTS.
(C ♯). Hypo-Lydian.	(F ♯). Lydian.	(b). Hyper-Lydian.
(C). Hypo-Æolian.	(F). Æolian.	(b♭). Hyper-Æolian.
(B). Hypo-Phrygian.	(E). Phrygian.	(a). Hyper-Phrygian.
(B ♭). Hypo-Iastian.	(E ♭). Iastian (or Ionian).	(a♭). Hyper-Iastian.
(A). Hypo-Dorian. (Called Æolian in Pindar's time.)	(D). Dorian.	(G). Hyper-Dorian (or Mixo-Lydian).

The order begins with the Hypos, as the lowest scales, viz., A to C♯; then the Principals, D to F♯; and lastly the Hypers, G to "b." The highest three Hypers, "a," "b♭," and "b," are the same notes as the three lowest Hypos, but are the Octave above them. These were unnecessary except in relation to their Principals. The entire compass of the scales was three Octaves and a tone from a fixed pitch.

When the Greeks modulated from one key into another, they did so exactly as we do now, by some sound common to both keys. They did not always fly to discords to change to a connected key, as was the fashion even in the present century. The greater the connection between the two scales, the better was the modulation esteemed by them, as by us.[a]

They had four kinds of modulation, called "mutation," or change, (*Metabolē*).[b] One kind was described as "according to *genus*," being such as a transition from the Diatonic to the Chromatic or Enharmonic scale; a second was a change of *system*, as from the Conjunct to the Disjunct scale, or *vice versâ*; the third was a change of key or mode (*katà tónon*) as from Dorian to Phrygian; and the Fourth a change of *Melopœia*, *i.e.*, in the style of singing

[a] Euclid, p. 21., edit. Meibom.

[b] "Μεταβολὴ δὲ λέγεται τετραχῶς, κατὰ γένος, κατὰ σύστημα, κατὰ τόνον, καὶ κατὰ μελοποιΐαν."—Euclid, p. 20.

or chanting, as from grave to gay, or from a love song to a martial one.

When a Greek system, or scale, was called "*ametabolē*," or, without mutation, such a translation as the ordinary one, "immutable," conveys a wrong impression, for it means nothing more than an ordinary scale, tuned to one key-note,[a] and usually a Diatonic scale.

There is a passage referring to the added Octave tone at the basis of the Greek two-octave scale, in Plutarch's *Commentary on the Timæus* of Plato, which has created a difficulty for many writers on Greek music. It has led them to suppose that this tone, called *Proslambanomenos*, was originally at the top of the scale, and not at its base. Boeckh erroneously inferred from the passage that the Octave below the key note was not in use in the time of Plato.[b]

Plutarch's complaint is[c] that innovators, (*neōteroi*,) by adding *Proslambanomenos* as an Octave below the key-note, at the base of the "Greater System" or two-octave scale, had introduced a tone below *Hypate*, which was formerly the lowest sound. By which, said he, they have made the ascending sequence of the consonances to differ from the order of nature, for they have thus placed a Fifth below a

[a] "*Καὶ τὰ μὲν ἀμετάβολα, τὰ μίαν ἔχοντα μέσην· τὰ δὲ μεταβαλλόμενα, τὰ πλείους ἔχοντα μέσας.*"—Arist. Quint., p. 17, and to the same effect, "*ἁπλᾶ πρὸς μίαν μέσην ἡρμοσμένα.*"—Euclid, p. 18.

[b] Is tonus (Proslambanomenos) Platonis tempore nondum receptus usu fuit."—*Metres of Pindar*, p. 206.

[c] "Οἱ *δὲ νεώτεροι τὸν προσλαμβανόμενον, τόνῳ διαφέροντα τῆς ὑπάτης ἐπὶ τὸ βαρὺ τάξαντες, τὸ μὲν ὅλον σύστημα δὶς διὰ πασῶν ἐποίησαν· τῶν δὲ συμφωνιῶν τὴν κατὰ φύσιν οὐκ ἐτήρησαν τάξιν· τὸ γὰρ διὰ πέντε πρότερον γίνεται τοῦ διὰ τεσσάρων, ἐπὶ τὸ βαρὺ τῇ ὑπάτῃ τοῦ τόνου προσληφθέντος· ὁ δὲ Πλάτων δῆλός ἐστιν ἐπὶ τὸ ὀξὺ προσλαμβάνων.*" — Plutarch, *Comment. De Animæ Proc.*, Reiskii edit., 1029, lin. 20, p. 262.

Fourth, whereas the Fourth ought to have been the lowest interval of all. "It is clear," he adds, "that Plato *added on* to the acute part of the scale." He does not there say that Plato fixed the particular string, called *Proslambanomenos,* at the top of the scale, as some former readers have understood.

The passage about Plato's additions to the scale is not to be found exactly as Plutarch expresses it in the *Timæus,* but Plato there speaks of circles within circles, and of musical proportions, which must have been calculated by some disciple of his school, who then reduced them to a scale. It is quite a celestial scale, for it refers only to the music of the heavens. The substance of those calculations is stated by Plutarch's cotemporary, Theōn of Smyrna, (who quotes from Adrastus,) as well as by Proclus. It does not bear out Plutarch's words as to the Octave below the key-note having been excluded from the computation, but only that "Plato extended the greater system of the Diatonic scale to four Octaves, a Fifth, and a Tone."[a] Therefore he included this lowest note. The rest is Plutarch's surmise; but, very possibly, a correct one, so far as the heavenly bodies were concerned. The passages in both authors relate to the harmony of the universe, which had first been adapted by the Greeks to their shorter musical scale, and *Hypate* then represented Saturn, "the slowest in motion of the planets, and furthest from the earth." Saturn was then placed at the distance represented by a musical Fourth, from the Sun; in other words, there were two planets, Jupiter and Mars, between Saturn and the

[a] "Ὁ δὲ Πλάτων καὶ γένος διάτονον καὶ συστήματος μέγεθος εἶναι τὸ τετράκις διὰ πασῶν, καὶ διὰ πέντε καὶ τόνον προαγήοχεν."—Theon, p. 97, edit. Bulliald.

Sun, and the Sun, as the centre of the planetary system, was Mese, the key-note to the whole, Saturn being *Hypate*, represented by the lowest note as to pitch.

The systems of Copernicus, Kepler, and Newton, as to the planets revolving round the Sun, were prefigured by Pythagoras, and there can be no doubt that his knowledge of the revolutions of planets in their orbits, as well as his general system, were derived from the observations that had been made for many preceding ages by Egyptian and Babylonian astronomers. It was Claudius Ptolemy, some six centuries after Pythagoras, who first propounded the doctrine that the earth is the unmoved centre of the universe, a theory which took such hold of Roman Pontifs as to cause the retention of the book of Copernicus in the *Index Expurgatorius* of Rome, until the decree of Paul V. was revoked by Pius VII., so recently as in 1821.

Whether the confusion of order among the heavenly bodies has been so great as represented by Plutarch, in consequence of the addition of a note to the musical scale, is a question we must leave to be determined by Pythagorean philosophers, and by our present learned *Mousikoi*, the astronomers. As to mere mundane music, it is not so, and we must even defend the supposed "innovators" from their part of the charge made by Plutarch; for, long before the date of Plato, Anacreon had used the Egyptian Magadis, and still a thousand years before that, the Egyptian lute, or Nefer, had its two-octave scale. The double flutes, Egyptian and Greek, the *antiphōns*, *antistrophes*, and all the musical *antis* of the Greeks, signified an Octave below another note, so that any compass of one Octave must have thereby created a two-octave scale.

CHAPTER VI.

Greek singing.—Its high pitch lowered by Claudius Ptolemy.—The scales on the lyre.—Reason for the names given to Greek Octaves.—Scales differed only in pitch.—No names for notes.—Greek-written music and plan of tuning the lyre.—Test of imperfect Thirds.—Greek Chromatic scale had neither Fourth nor Seventh.—Enharmonic scale.—The scale of Olympus, or Common Genus.—The Chroai, or varied tunings of scales.—Their names.—The six peculiar scales, called "very ancient" by Aristides Quintilianus.—What they really are.—Doubts as to the age of this writer.

It is clear that ancient Greek singing must often have caused a severe strain to the voice. If we take the lowest of the five principal middle scales, the "manly and severe" Dorian, the key-note was tenor "d," in the space immediately below the treble clef, and the Octave below it was D on the third line of the bass. Suppose only the small lyre or Kithara, if an Octave in compass. It would extend a Fourth below the key note, viz., to tenor "a," and a Fifth above it, to treble "*a*." That is a high chest note for an ordinary tenor voice.

Our ancient Greek must have thrown back his head, and have filled his chest to the fullest, if he wished to declaim his "severe, firm, and manly" addresses to Apollo from so high a key-note as D. Aristotle says that few persons could sing the Nomes, called "*Nomoi orthioi*," on account of their high notes (Prob. xxxvii. Sect. 19). That may readily be imagined. The comment, however, tends to show that regard was paid to pitch; and Plutarch

says of Nomes, that they were not to be transposed.[a] Yet, on the other hand, are we to assume that all were debarred from chanting to Apollo who could not sing so high? Some of the ancients invited the god to supper, and must then have addressed him. Perhaps they only took part in a pæan.

The public crier is now out of fashion in large towns; but many may recollect him in former days, with his old French "Oyez! oyez!" (Hear! hear!) corrupted into "O yes! O yes!" and how he assumed the highest possible pitch of voice for his announcements. With all due respect for antiquity, we can but fancy the singing of an ancient Greek to the gods to have been something of the same kind; and, considering that the most correct Nomes were upon three notes, it would be difficult now to decide whether such singing differed widely from that of the ancient Greek crier, with his *Akouete Leō!* "Hear, ye people."

Apollo seems to have been addressed as if he had been troubled with deafness, or was supposed to be a long way off; and, perhaps, that was the general style of heathen antiquity. It recalls Elijah's mockery of the priests of Baal—telling them to "cry aloud: peradventure he sleepeth, and must be awakened."

It may be assumed that the Greek key-notes were fixed so much higher than the conversational tone of the human voice with the object of being more distinctly audible to a large assemblage, especially to one in the open air. Modern speakers, about to address a crowd, often adopt the same course, though, perhaps, in a modified form. They

[a] *De Musica*, cap. 6.

assume the high pitch in order that their voices may not be mixed up and lost in the conversations of those who are around or beneath them.

The Phrygian mode may well have sounded "enthusiastic" or "bacchic," if sung from the chest voice, with tenor "e" as key note. It would cause a great strain upon ordinary lungs; and, as to the "mournful" and "plaintive" character attributed to the Lydian, it can but have been mainly, if not altogether, owing to the necessity of employing the head voice to squeeze out the high notes. The singer must have resembled the high tenor, who sings the accepted lover's part in modern operas. Few men could avoid resorting to the head voice, if they were to sing with such a key note as the high "f" sharp of a tenor voice. Plutarch states that the reason why Plato would not tolerate the Lydian mode was on account of its acuteness and fitness to express and excite plaintive and mournful affections.[a]

On the other hand, it is not to be supposed that any large majority of voices could have "distinctly audible notes" below our A in the base; so that the variation between ancient and modern pitch cannot have been very material. In all probability a tone was the extreme, unless the human voice has diminished in compass, which is a theory not to be upheld. Aristoxenus and Euclid fixed the *limit* of the most extensive voice at two Octaves and a Fifth, which is much the same as now. There is also this against the theory: that Hypo-Dorian was included in Dorian, and, for general voices, it answered far better to the character of firmness

[a] *De Musica*, cap. 15.

and manliness ascribed to the mode, than its principal.

The Hypo-Dorian compass upon the Octave lyre would have been from E to "e," with the intermediate "a" for key-note, which was, and still is, quite within the reach of men's ordinary voices. Suppose only half a tone lower to be allowed for variation between ancient and modern pitch, there would be but an exceptionally low base voice that could not sing to the highest of the notes. Moreover, Euclid prefaces the name of the Hypo-Dorian scale with the title of "Common," as well as of "Locrian" (for Locrian songs,) which were erotic, or Anacreontic.[a] Aristotle says it was most suited to the Kithara, as being the most stately and stable of modes;[b] and Athenæus says that Hypo-Dorian songs were sung by nearly everybody.[c]

For ordinary purposes, therefore, the Greek compass was very much the same as that of to-day, and we might add that Plato's advice to the singers and reciters of his time would be just as applicable to any who would wish to sing ballads well, as if given by the highest modern authority. It is "to make the metre and the air subserve to the sentiment of the words, and not to allow the due expression of the words to be subservient to the time-beats of either metre or music."[d]

In order to remedy the obvious defect of too high key-notes in the principal Greek scales, Claudius Ptolemy proposed, and carried out, the lowering of

[a] *Introd. Harmonica*, p. 16.

[b] "Ἡ δὲ ὑποδωριστὶ μεγαλοπρεπὲς καὶ στάσιμον· διὸ καὶ κιθαρῳδικωτάτη ἐστὶ τῶν ἁρμονιῶν."—Prob. xlviii. Sect. 19.

[c] Athenæus, lib. xiv. cap. 19.

[d] "Τὸν πόδα τῷ τοιούτου λόγῳ ἀναγκάζειν ἕπεσθαι, καὶ τὸ μέλος, ἀλλὰ μὴ λόγον ποδί τε καὶ μέλει."—*Republic*, lib. iii. p. 400 a.

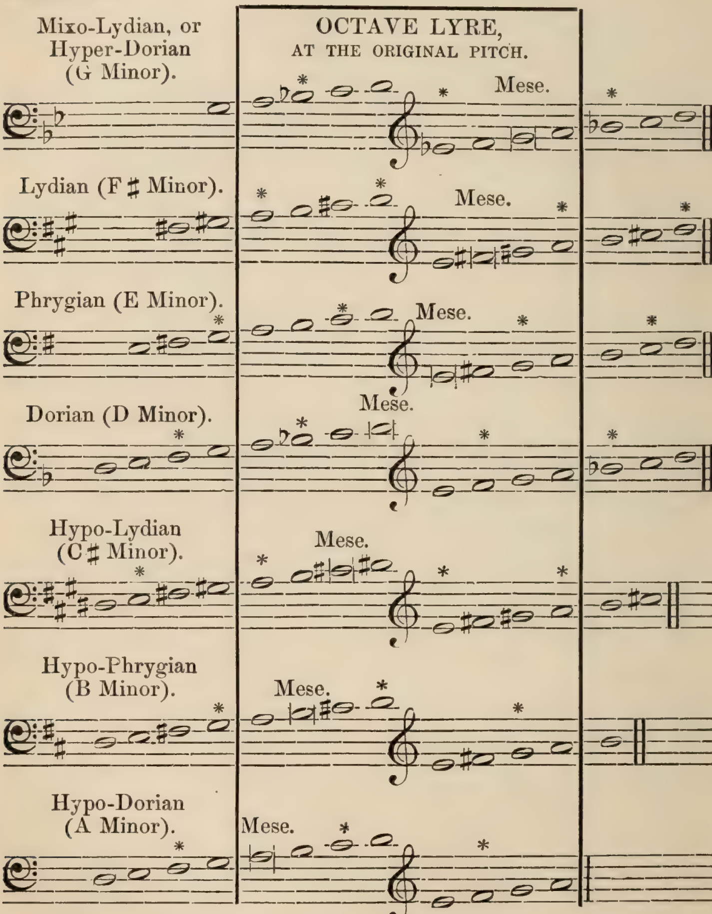
the seven scales particularized by Bacchius, to the extent of each a Fourth; to bring, as he said, an Octave of all into the middle of the voice instead of its higher extreme. The advantage thus gained will be better brought before the eye of the reader, by first presenting the scales in musical notes in their original keys, and afterwards as transposed by Ptolemy.

The eight inner strings in the following diagram, the notes of which are bounded by a line at each end, are for the Octave lyre. The added notes, both before and after those two boundary lines, are for the fifteen-stringed, or two-octave, lyre. The instrument was tuned in the usual way, first to the Dorian scale, which occupied the centre of the seven, and was always esteemed to be the principal. The sharps and flats at the signatures are here repeated with the notes, but only in order that the eye may catch the number of those that would require re-tuning, or an additional string, to change from one key into another. It will be found that to modulate from a principal key to its Fifth or Fourth, (Hypo or Hyper,) required only the change of one string for each of these two secondary or accompanying keys, so that a ten-stringed lyre, or Kithara, would enable the singer to employ those three keys at command, if he chose so to arrange his lyre.

Just so a singer of to-day begins to sing a ballad, say in the key of C, and wants the accompaniment of chords in the keys of F and G, which are the Fourth and Fifth, or Subdominant and Dominant of that key. The only additional notes required are a B flat for the one, and F sharp for the other. All the other notes are the same in the three keys.

It is thus in all keys. The addition of two strings is all that could have been required for the two usual changes or modulations.

Stars are placed over the notes of the following scales, to mark where the ascent has been but a semitone :—

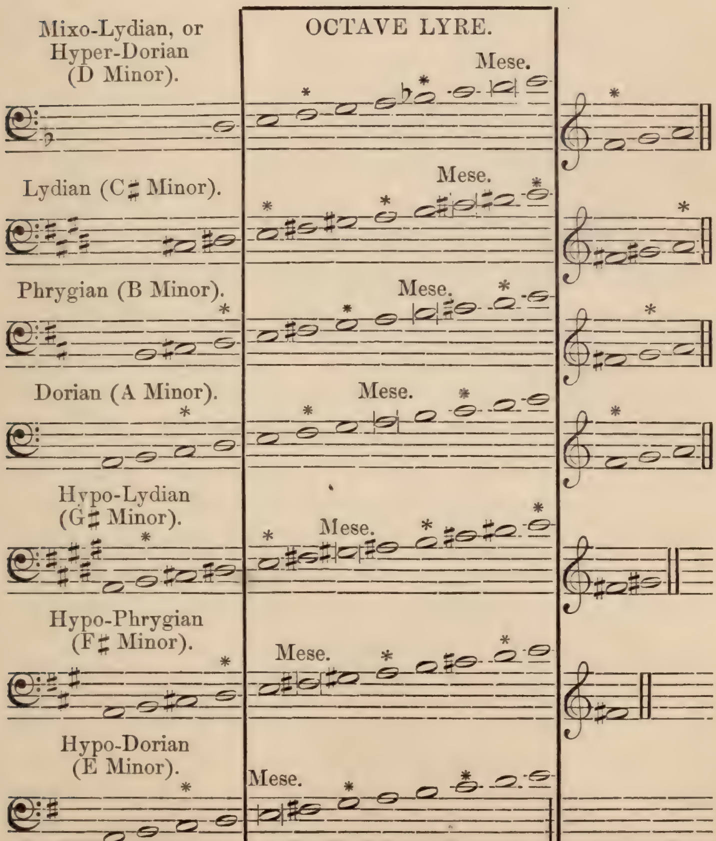


In all the above scales the Octave lyre is tuned from tenor "a" to treble "*a*," and in the following the pitch is lowered from bass E to tenor "e."

Each of the seven scales starts from a different part of its Octave. A, in the preceding, and E, in the following, is in turn second, third, fourth, fifth, sixth, and seventh note of a scale, and, in the lowest, it is key-note.

The Dorian occupies the same place in both diagrams, and all the other key-notes follow in the same order as before. The semitones, too, occupy the same places as before.

THE SEVEN SCALES, AS TRANSPOSED A FOURTH LOWER, BY CLAUDIUS PTOLEMY.



The description of the various Greek Octaves, called Lydian, Phrygian, or other, by Euclid, Gaudentius, Bacchius,[a] and other ancient writers, will be found to tally with the intervals of their particular modes, as they begin upon the Octave lyre, in both the preceding sets of scales. Transposition makes no change in that respect. If the lyre were tuned for any one mode specially, the only Greek Octave that could be included, on the Octave lyre, would be from the Fourth below the key note, to the Fifth above it, as here shown in the Dorian. It would have no Octave up from the key-note itself; but then, the Hypo-Dorian, being always tuned a Fourth below the Dorian, would, by the same rule, commence on its key-note and include the Octave above it, and no other.

A fifteen-stringed lyre could only include one of the two-octave scales complete. As there are seven scales of different pitches, six more strings would have been required to include fifteen notes of all. So, some of the highest notes of the higher scales, and of the lowest notes of the lower, are necessarily omitted in the preceding diagrams, as they were omitted on the lyre.

The names given to the Greek Octaves, which were thus derived from the changing positions of the eight notes of an Octave in the different modes on the lyre when the Dorian was the central one, have been one of the greatest puzzles to writers on Greek music. Some inferred that each particular kind of Octave belonged exclusively to, and was identical with, its mode; whereas, every kind of Octave is common to every mode or key, and the transposed scales prove that

[a] Euclid, p. 15; Gaudentius, pp. 19, 20; Bacchius Senior, pp. 18, 19.

the intervals of all keys are alike if begun upon the same part of their scale. It is a misconception about Greek Octaves that underlies the Greek names given to the old scales of the Church, now called Gregorian. They are not scales, but *Octaves* in the Dorian or Hypo-Dorian mode, and yet had such names as Lydian and Phrygian assigned to them. To be really Lydian or Phrygian they should have been taken in Lydian or Phrygian keys. If their Octaves had been properly selected from their respective keys, they would have had the same sharps and flats as other music.

One continuous proof runs throughout all ancient treatises on Greek music, that every mode or scale was tuned in precisely the same way, viz., always to its own *Mese*, or key-note. For that reason alone, if there were no other, Greek scales of the same genus must have been identical as to intervals, just as are modern scales.

I have already remarked that there was no complete major scale among the ancients. Every Greek writer insisted upon the interval of a whole tone, at least, immediately below the key-note. The distances of tone or semitone, for every string, are given by ancient writers, and they invariably make a complete old minor scale. There is no major Third, no major Sixth, no major Seventh, among them; and if one Diatonic scale had differed from another, the mathematical proportions of Euclid, and others, could not have been given as applicable to all. The diagrams of Alypius, of Claudius Ptolemy, and others, down to that of Boethius, all alike prove that one Greek scale differed from another in nothing but pitch. "The tones," says Bryennius, "differ from one another in no other respect than in their

positions as to acuteness and gravity, as has already been shown."[a]

Yet this has been termed a "laughable" assertion by Boeckh, in his *Metres of Pindar*.[b] He fancied there could be no character attached to a Greek mode, but by changing the order of the intervals of tone and semitone in the scale, as they are changed in ecclesiastical modes, or tones. It must be supposed that he derived his knowledge of what was said to be Greek music, through over-zealous writers on Church music, and had entirely formed his judgment upon them. He cannot have derived it from the Greek treatises on music.[c]

It will be observed, in the preceding diagrams, that as the key-note shifted to the right, another note of the scale was taken in on the left, and so the Octave began upon a different part of every scale.

The form of Octave that began on the *second* ascending note of its key was called Mixo-Lydian, just as here; that which began on the *third* was Lydian; on the *fourth*, Phrygian; on the *fifth*, Dorian; on the *sixth*, Hypo-Lydian; on the *seventh*, Hypo-Phrygian; and the one beginning on the *key note*, or its *Octave*, Hypo-Dorian.

The difference between one kind of Octave and

[a] "*Καὶ γὰρ οὐδενὶ ἑτέρῳ οἱ τόνοι ἀλλήλων διενηνόχασιν, εἰ μὴ τῷ τε ὀξυτέρῳ καὶ βαρυτέρῳ τόπῳ τῆς τε φωνῆς καὶ τοῦ ὀργάνου· ὡς ἐν τοῖς ἔμπροσθεν δέδεικται.*"—(Bryennius, p. 481, fol., Wallis's edit.)

[b] "Etenim quum ridicula vulgo sententia invaluisset, veterum modos non nisi ratione acuminis et gravitatis differre."—(*De Metris Pindari*, cap. vii. p. 217.)

[c] Boeckh sometimes touched upon mediæval music, and showed the inferior character of the books he had been reading — "Jam vero Guido Aretinus, qui recepta temporibus nostris sonorum nomina, siglas que musicas invenit." (*Idem*, p. 214.) I shall hereafter show cause to differ as widely from Boeckh's version of the discoveries he here attributes to Guido, as about his interpretations of Greek music. It is clear that Boeckh had not read Guido's works.

another was as to where the two semitones would occur. If the Octave began on the key note, the scale being minor, the semitones would be found in ascending from the second to third, and from the fifth to the sixth strings. If on the second of the key, as the Mixo-Lydian Octave, they would occur in ascending from the first to the second, and from the fourth to the fifth strings. That these are the true distinctions between Greek Octaves may be verified by comparing the above with Euclid's description of them (pp. 15, 16). The names of the strings of the lyre have been here dispensed with, as they would only perplex the reader; but they may be tested by the curious upon the preceding "Greater System"—(at p. 97).

There was an old plan of teaching singing to boys in English Cathedral schools, and one that has been revived as a novelty of late, in which *Ut*, (or *Do*,) was always the key-note, like the *Mese* of the Greeks. This system was identical with that of the Greeks, for every other note in the scale took its name from its position in respect to *Ut*, as the Greek did to *Mese*, and had no fixed sound. With every change of key, *Ut* became a different note, and every other followed suit. The chorister thus acquired a little knowledge of harmony at the time he was learning to read music; and it was supposed necessary to teach harmony to choristers in those days, although it is sometimes dispensed with at the present date.

Although the Greek names for notes were thus unfixed and variable, according to the positions they might occupy in any mode, or key, they had fixed and distinctive marks or signs for all notes when

written down upon paper. These "music signs" (*sēmeioi mousikoì*), were letters of the alphabet, turned about in various directions, and sometimes only parts of letters were used. The Greeks practised writing down music as early, at least, as in the fourth century B.C., for Aristoxenus complains that too much had been thought of it, and too much credit had been taken for what was purely mechanical, and not part of the science of music (p. 39).

The following graceful figure of a girl reading music from a book, is given by Dr. Burney, from an ancient bas-relief in the Ghigi Palace at Rome.

Reading Music.

Aristides Quintilianus attributes the system of musical notation for the fifteen modes, and in the three genera, Diatonic, Chromatic, and Enharmonic, to Pythagoras (p. 28). Whenever we read of musical improvements by Pythagoras, we may fairly suppose them to have been derived from Egypt.

The SYSTEM OF TUNING the seven scales was by first taking a pitch for the key-note of the highest,

the Mixo-Lydian, *alias* Hyper-Dorian, and then tuning by intervals of Fourths down and of Fifths up. Suppose that key-note to be "d," as in the transposed scales, tune a Fourth below it, for Dorian ("a"), then another Fourth down to Hypo-Dorian (E), which is the lowest of the scales. From that, tuning a Fifth up, will give the Phrygian pitch (B), and thence a Fourth down, the Hypo-Phrygian (F ♯). From this last another Fifth up gives the Lydian (C♯), and lastly, a Fourth down, the Hypo-Lydian (G♯). These are the directions of Claudius Ptolemy divested of their Greek technicalities. (Lib. ii. cap. 10.)

From the time of Aristoxenus, and, perhaps, long before it, the Greeks tuned their lyres by a Fourth down, and thence a Fifth up, because it measured the distance of a tone between the two upper notes. The Pythagorean tone was our major tone, it being the difference by which a Fifth overlaps a Fourth.

This tuning will afford an easy experiment as to the ancient major Thirds, called Ditones, to show how they were discords, instead of concords, and the value of the introduction of minor tones. Supposing neither violin, guitar, nor harp to be at hand, let the pianoforte-tuner be asked, on his next visit, to tune four notes *perfectly*, viz., from C, a Fourth down to G, and thence, a Fifth up to D, for the first major tone, and then from D down to A, and up to E, for the second major tone. Thus, from C to E will be a Pythagorean Third, or Ditone. The interval will be too wide for a true major Third, and quite discordant. If the tuner be not asked to tune the intervals perfectly, he will "temper" them all, so as to bring the major Third just bearable to

the ear. Thirds are no longer tuned perfectly upon pianofortes, because the notes are wanted for many keys, and keyed instruments are imperfect. If the tuner would then make F a perfect Fourth above C, the hearer could judge also of the Pythagorean *limma* or remnant, called by the Aristoxenians a semitone, as between E and F. He would thus know practically all that can be written about the systems of Pythagoras, of the Romans, of Boethius, and of all the most ancient tone and semitone scales for voice or instrument. The Fourths, Fifths, and Octaves were at all times the same as now.

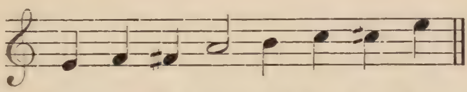
Claudius Ptolemy argues against having more than seven scales, or modes, but admits of an eighth, to complete an Octave. He says that, in a Fifth, there are three tones and a *limma*, "which they," (meaning the Aristoxenians,) "denominate a semitone;" that, in a Fourth, there are two tones and a *limma*—thus seven notes for scales in all. "If you add to them," says he, "you can but multiply divisions that you have already within the seven scales." (Lib. ii. cap 9.) If the moderns would but be contented with seven scales upon imperfect instruments, they might have them better in tune.

Before touching upon the improvement of the scale by Ptolemy, it is expedient to take up the thread of the Chromatic and Enharmonic systems of the ancients. They are of considerable interest in the history of the science, as well as of the art.

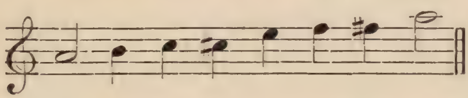
The Greeks seem originally to have had but one kind of Chromatic Scale, as one Diatonic and one Enharmonic; but they made many experiments

upon new ones, which were modifications of the first two, although without any durable success. For instance, Bacchius Senior names but one of each kind, so the varieties had all died away when he wrote.

The principal Chromatic scale, the original and the most enduring, was called, for distinction, the *Chrōma tonaīon*, by Aristoxenus. Euclid places it alone in the list of scales in the early part of his treatise, although he afterwards mentions the others, as called *Chroai*, or colours. We should, perhaps, term them "different shades" (p. 10). The principal Chromatic scale ascended by semitone, semitone, and minor Third. On the Octave lyre, taking "a" for the key note, it stood thus:—

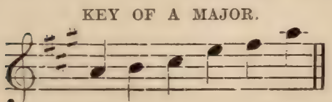


but in our Octave scale it will begin thus:—

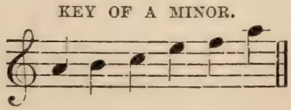


The peculiarity is, that it includes a minor scale without either Fourth or Seventh, and also a major scale without its Fourth and Seventh—or, in other words, a major scale of five tones, without semitones—a *pentatonic scale.* How truly the ear guided to the omission of the Fourth ascending from the key-note, and of the minor Seventh, is a subject to be explained hereafter. Dividing the above scale into major and minor, it stands thus:—

KEY OF A MAJOR.



KEY OF A MINOR.

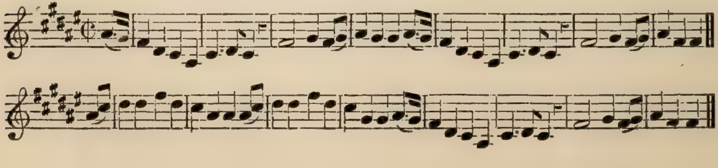


This Chromatic scale was of very simple formation on the lyre. It was only necessary to lower the forefinger string, and its representative in the higher tetrachords, half a tone below their Diatonic pitch, so as to make the interval between the highest string of a tetrachord and the next to it, a minor Third, instead of a tone. The other three strings of every tetrachord remained as in the Diatonic scale. This may be termed one of the skipping scales. It differs widely from the modern Chromatic, which includes every semitone in the Octave. The Greeks could only have obtained the extra semitones by changes of key, or mode. Still, they might have included all upon the fifteen-stringed lyre.

If the portion of the Greek Chromatic scale which is in a major key, be played in the Lydian mode, our F♯, it will be identical with the short keys (usually black) on a pianoforte, according to the reputed, but mistaken, test of ancient Irish and Scottish tunes [a]—"mistaken," because the Irish and the Scotch had as perfect scales as any of their neighbours, and this peculiarity was but a preference of many among them for the shorter scale.

As to the Enharmonic Scale, the following account of its origin is given by Plutarch, in his *De Musica*, cap. 11:—

[a] "A famous man was Robin Hood."—A tune in the Greek Chromatic-Lydian mode, if played an Octave higher than here written. All notes are on the black keys of a pianoforte.



"To Olympus, as Aristoxenus informs us, the invention of the Enharmonic genus is unanimously ascribed by the scientific world," (the "*Mousikoì*,")[a] "for, before his time, all was Diatonic or Chromatic. They conjecture such a discovery as this to have been made in the following manner:—While preluding up and down in the Diatonic genus, and frequently passing from B♭,[b] and from A [the key-note] directly down to F [the sixth of the key,] and thus passing over G, [the minor Seventh] in the descent, he observed the beauty of the effect; and, both astonished at, and approving it, he constructed a system strictly analogous to it, in the Dorian mode—for there was no sound in it that was peculiar to the Diatonic scale, neither any that belonged only to the Chromatic, nor to the Enharmonic genus.[c] Such was the first of the Enharmonic scales—that of Olympus."

This scale of Olympus was not considered to be Enharmonic either by Aristoxenus, or by Euclid. They name it the Common Genus, or "Common to all" scale, because it included only sounds that

[a] Practical musicians (if the designation does not imply science) were *organikoì*, (instrumentalists,) or *phōnaskikoì* (teachers of singing and declamation,) not *mousikoì*. (See Didymus apud Porphyry, p. 210, Wallis's edit.)

[b] Plutarch can only mean the *ancient* Paramese of the *Conjunct* system, B ♭, (before the eighth string was added to the lyre,) for no ears could be struck with the beauty of such an interval as the Tritone of the Disjunct or Octave system, from B natural down to F. It must have been B ♭ to F, and so have been the fall of a Fourth. The name of Paramese in the Synemmenōn tetrachord of the Conjunct system was changed to Trite ages before Plutarch's time, and remained only in the Disjunct system; but he was quoting Aristoxenus for a story going back nearly to the time of Terpander. Plutarch's use of this word, *Paramese*, has been a difficulty to unmusical readers.

[c] In Teubner's edition of Plutarch's *De Musica*, the word, *ἤδη*, has been substituted for the *οὐδὲ* of the old text, in "*ἀλλ' οὐδὲ τῶν τῆς ἁρμονίας*," without any note to tell of the arbitrary change. It has been made unnecessarily, and injuriously,

were common to the three genera.[a] It lacked the distinguishing feature of the Enharmonic, viz., the quarter-tone between the lowest two strings. It was but the old Diatonic minor scale, wanting its Fourth and minor Seventh. The three permanent sounds in every tetrachord, whether Diatonic, Chromatic, or Enharmonic, were the two extremes, and the semitone above the lowest. That semitone was usually occupied by the Parhypate string; but, in the Enharmonic genus, Parhypate was moved down to within a quarter-tone of the lowest, and Lichanos took Parhypate's place. The reason why this scale of Olympus has been such a puzzle, is simply because this movement of one string into the place of another was not thought of.

As to the story about Olympus, it is an indirect way of fixing upon him the first discovery that the Fourth and minor Seventh do not properly belong to the scale of the key-note. But there was Egypt, long before him, and hundreds of cases after him, in which that discovery was made by the ear, without any knowledge of what Olympus may have effected. These discoverers by ear were strictly correct, as will be proved hereafter. Those notes belong only to the tetrachord, and not rightly to the Octave system.

upon an old suggestion by Burette, who admitted his imperfect knowledge of the Greek system. The musical sense is clear, although Burette did not see it. Plutarch can only mean that there was no sound peculiar to *any* of the three genera, and that what he calls the "Enharmonic" of Olympus, was simply composed of the three sounds of the Diatonic scale, which three were retained in all the three systems. In the Enharmonic scale, one string took up the relinquished place of another, so there were still three notes alike in all tetrachords. That is what Burette did not observe. Herr Volkmann should see that the text of Plutarch be restored in the next edition, both here and in the case before pointed out.

[a] Aristoxenus, p. 44, Meibom's edit., and Euclid, p. 9, lin. ult.

Olympus, who, according to Plutarch, was a flute-player of Phrygian extraction, "must have flourished a short time after Terpander," says Müller[a]—in other words, after Egypt had been thrown open to the Greeks. To have found out the defects of those two notes, a man must have had the Octave system in his ear. It is to be remarked that the Chromatic, as well as the Enharmonic, omits the Fourth and minor Seventh, and that the Chromatic was admittedly older than Olympus. Those two notes have been shunned by susceptible ears *in simple melody*, in all ages. When the ancient Chromatic and Enharmonic scales fell out of use, *we may be sure that music had advanced beyond simple unaided melody* into the stage of accompanying the voice with varied harmony.

Now, as to the reason for the introduction of an Enharmonic quarter-tone. While the Chromatic scale made a skip downwards of a minor Third, (as from key-note A to F ♯,) the Enharmonic made the greater skip of a major Third, (as from A to F ♮). But there was a string already upon that note, and the question would naturally arise as to what should be done with the unemployed string. It was not required where it stood, and there remained but the interval of one semitone into which it could be packed. So the otherwise useless string was eventually placed at a quarter-tone between the two strings, to give an occasional grace-note. That is the simple origin of quarter-tones in Greek music. It could not have been employed practically in any other way than as a grace-note.

"As to the quarter-tones," says Aristoxenus,

[a] *Literature of Greece*, p. 202.

"no voice could sing three of them in succession," (p. 53,) "neither can the singer sing less than a quarter-tone correctly, nor the hearer judge of it," (p. 14). There are numerous comments upon the quarter-tone to this effect, and to its unfitness for harmony. When, therefore, we read of the Enharmonic genus having been so much in use before the time of Aristoxenus, as almost to exclude the other genera, we should think of it as of an ordinary scale without either Fourth or Seventh, adding only thereto the possibility of an attempt at a quarter-tone by the singer.

"As to the intermediate quarter-tones of the modern Enharmonic," says Plutarch, "these do not seem to have constituted any part of the invention of Olympus, and the difference between the two methods may be immediately perceived by any one, on hearing a piece played in the ancient manner; as, in that case, no division is made of the semitone." He adds that "the division of the semitone came afterwards into use in the Lydian and Phrygian modes." It might have been suspected in the Lydian only, for such a refinement was best fitted for tearful, or very amatory ditties.

When Aristoxenus complains that his predecessors had taught only the Enharmonic division of the scale, and the compass of but one Octave, it is to be understood in a general sense, and of immediate predecessors only. In proof, Archytas of Tarentum, the cotemporary of Plato, defined the three genera, and suggested a new division of the intervals, which has been preserved by Claudius Ptolemy. (Lib. i. cap. 13.) Plato did not limit himself to one genus; neither did Aristotle. Nor can it be understood of

still earlier men, such as Philolaos, from whom quotations have been here given.

When the Enharmonic system was greatly in vogue in Greece, it took the name of Harmonia, as if the only system of Music. Aristoxenus, who complains of this, himself calls it "*Harmonia*" at the beginning of his treatise (pages 2, 7, and 8), and *Enharmonia* at pages 19, 21, 24, 25, and 26. In the last-named page, he uses *Harmonia* once, and *Enharmonia* thrice. Aristoxenus entitles his own treatise *Harmonikē*,[a] and that became eventually the more general name for "Music proper," and prevented confusion between the two meanings of the earlier word. Aristotle seems occasionally to have used *Harmonia*, where it is to be understood of only the one branch, viz., *Enharmonia*; but, at other times, he distinguishes that system by its more limited name of *Enharmonia*, as in Problem xv. of Sect. 19. It is not always possible to tell which of the two may have been intended by him. Euclid draws the line between the two words.[b]

After the time of Aristoxenus, there was little else than complaint in the opposite direction, viz., that the Enharmonic and Chromatic scales were neglected, and that nothing but the Diatonic was used. This continued till Greece fell under the dominion of the Romans, who may be said to have employed no other than Diatonic scales.

There were certain variations from the usual Diatonic and Chromatic scales, through a different tuning of the intervals. These were called *Chroai*,

[a] Ἀριστοξένου Ἁρμονικῶν Στοιχείων πρῶτον, and in the first sentence, τὴν ἁρμονικὴν καλουμενὴν.

[b] As "ἐν μὲν ἁρμονίᾳ οἱ ἐναρμόνιοι" (p. 7.), and "ἐναρμόνιον δὲ, τὸ τῃ ἐναρμονίῳ"—(p. 9).

or shades of colour. The notice of them by Aristoxenus proves that mathematicians had been at work, at an early date, to obtain new sounds from the scale; but, owing to the vague Aristoxenian mode of describing the notes as thirds, or quarters of tones, we cannot tell what mathematical proportions were adopted, except through the comparatively late work of Claudius Ptolemy, who preserves the divisions of Archytas, of Eratosthenes, and of Didymus. Neither the Octave itself, nor any musical interval within it, is divisible into equal parts; therefore, thirds and quarters of tones never were, and never could be; but there was an approach to those proportions in some of the scales.

The Diatonic had two *Chroai*, or shades, viz., the *Diatonon suntonon*, ("strained tight,") or called simply *Diatonon*, it being the chief characteristic of the genus, as before described, and the *Diatonon malakón*, or "Soft" Diatonic, in which the forefinger string was relaxed about a quarter of a tone, so as to leave, roughly speaking, only three-quarters of a tone between it and the next lower string, instead of a tone. Plato alludes to these two kinds of Diatonic; therefore even the second of them must have had an early origin.

The Chromatic had three *Chróai*, or shades. First, the ordinary *Chrōma*, or *Chrōma tonaīon*, before described. Secondly, the *Chrōma hēmiólion*, or Sesquialteral Chromatic, in which intervals of about three-eighths of a tone (an eighth added to each quarter-tone) were substituted for the semitones; and thirdly, *Chrōma malakón*, or Soft Chromatic, in which intervals of about a third of a tone were similarly employed.

There was but one Enharmonic.

To know only the proportions of one Fourth, in a Greek scale, is a sufficient index to the composition of the entire two-octave scale; because, at the base of each Octave was a "diazeuctic," or major tone, and after it, two conjunct tetrachords completed the Octave in our form, *i.e.*, counting it upwards from the key-note.

To show the divisions of one of these tetrachords, without fractions, the plan of Claudius Ptolemy (lib i. cap. 13,) is here adopted in preference to that of Aristoxenus, or of Euclid.—(*Introductio Harmonica,* pp. 11, 12.)

Aristoxenus and Euclid count six for a semitone, and twelve for a tone; so that a Fourth, being made up of two tones and a semitone, counted as 30. Ptolemy doubled those numbers, because the Sesquialteral Chromatic must otherwise have been expressed by $4\frac{1}{2}$. With him, therefore, a quarter-tone, (or Enharmonic *diesis,*) is 6; a semitone is 12; and a tone 24; thus representing the complete tetrachord by 60.

The six scales are here placed side by side to facilitate comparison, although the three principals, here in larger letters, have already been explained.

DIATONIC	......(*Diátonon súntonon*)...	12, 24, 24=60.
SOFT DIATONIC[a]	...(*Diátonon malakón*)...	12, 18, 30=60.
CHROMATIC	...(*Chrōma tonaîon*) ...	12, 12, 36=60.
SOFT CHROMATIC	...(*Chrōma malakón*) ...	8, 8, 44=60.
SESQUIALTERAL CHROMATIC	......(*Chrōma hēmiólion*) ...	9, 9, 42=60.
ENHARMONIC	....	6, 6, 48=60.

[a] The word "Diatonic" has usually been derived from *dia* and *tonos,* from the scale passing through five tones; but that would not apply to the soft Diatonic. Rather, then, from *dia* and the verb, *teinō,* to stretch; the movable strings being of higher tension than in other genera—"ἐπειδὴ σφοδρότερον ἡ φωνὴ κατ' αὐτὸ διατείνεται."

Aristides Quintilianus describes six other scales as Enharmonic, which, according to all earlier authorities, are mixed modes, having Enharmonic quarter-tones. He reports them as "very ancient."[a] The internal evidence of this treatise shows that Meibom ascribed too remote a date to the writer. Meibom seems to have been desirous of magnifying the importance of the addition he was about to make to musical history, by being the first to publish Aristides' treatise. He ranks the author as preceding Claudius Ptolemy, quite overlooking the fact that he borrows the above division of the scale into 60 parts from Ptolemy. I can hardly suppose Aristides Quintilianus to have lived earlier than in the fourth century, and more probably a century or two nearer to our own time. In the first place, he is the only Greek writer who places G and G♯ at the base of his scale.[b] As to this G, (which mediæval writers distinguished as Gamma, because there was already a capital letter, G, an Octave above it, in the ecclesiastical scale,) Guido describes it as a "note added by the moderns." Next, Aristides must surely have lived when all scales but the one common Diatonic were forgotten. He would not otherwise have misinterpreted Plato in a musical term relating to one of the forgotten scales; or suppose that he intended to apply the adjective, *súntonon*, to an Enharmonic division of the tetrachord, when there was but one Enharmonic.

[a] "Αἷς καὶ οἱ πάνυ παλαιότατοι πρὸς τὰς ἁρμονίας κέχρηνται."—(p. 21, l. 4.)

[b] "Si, qui omnium est gravissimus, Hypodorium per tonum in grave remittamus, ipsum Omega sumimus notarum principium."—(p. 25 of Meibom's translation.) At p. 27, Aristides marks this Gamma of Church scales by a double square-shaped Omega; and the G sharp half a tone above it, in the next line of double signs, by double Chi, with a stroke through each.

The Enharmonic is the very opposite to *súntonon*, viz., the *malakōtaton* of all scales—the first meaning tightly drawn, and the second the softest or most relaxed in the tuning.[a] Plato refers to the two kinds of Diatonic-Lydian, and, therefore, he adds the otherwise unnecessary prefix of *súntonon* to the principal one, and applies *malakōn* to the other.[b]

The Enharmonic scale, to which Aristides Quintilianus has given the name of *Súntono-Lydian*, is what every other Greek writer, early and late, has termed Hypo-Lydian; and the inference to be drawn is, that the mistake originated with the copyist of the old manuscript which he used, and that he lived at too late a period to detect it. He himself says that the Enharmonic scale is indivisible (p. 133); therefore, there cannot have been any second kind, and no prefix to the name could be required.

A third argument for the late date of this author is, that his system of musical notation has many changes from the system of Alypius, so that the one will not serve throughout to explain the other. The

[a] "*Συντονωτάτη διάτονός ἐστιν.*"—(Aristox., p. 25. See also Euclid, p. 11, and Claud. Ptolemy, p. 30, fol.) Aristides Quintilianus' description of scales, at p. 20 of his treatise, agrees with the preceding diagram, and there are to be found both the *súntonon* and the *malakón diátonon*, but no other kinds of *súntonon*.

[b] "*Τίνες οὖν θρηνώδεις ἁρμονίαι; . . . Μιξολυδιστί, ἔφη, καὶ συντονολυδιστὶ καὶ τοιαῦταὶ τινες . . . Τίνες οὖν μαλακαί τε καὶ συμποτικαὶ τῶν ἁρμονιῶν; Ἰαστί, ἦν δ' ὅς, καὶ λυδιστὶ, αἵτινες χαλαραὶ καλοῦνται.*" — (*Republic*, lib. iii. 399 a.) The meaning of the passage is this. If you take your key note, and principal note, so high as tenor "g," or tenor "f" sharp, (*i.e.*, Mixo-Lydian, or tightly-tuned Lydian,) you make mournful music (*θρηνώδεις ἁρμονίαι*). Even with the *relaxed* tunings of "f" and of "f" sharp, (soft Iastian and soft Lydian,) your tones are still either effeminate, or as if excited by wine. You should bring down the pitch of your music more within the natural compass of man's voice to fit it for the utterance of warlike men—Dorian and Phrygian (D and E), are alone suited for them.

system of Aristides Quintilianus is a universal one for all modes, and he gives the notation for every semitone in the entire scale.[a] This is a great improvement, but one unknown to Boethius, who wrote in the sixth century—yet Aristides does not give it as his own system, or as any novelty, but as the recognised plan.

The date that Meibom has assigned to him has been so universally adopted by the learned, that it has become necessary to show cause for dissent. The scale that Aristides termed *Súntono-Lydian* in the ancient set of scales may be seen to be Hypo-Lydian, by having its key-note on the third ascending string of its Octave on the lyre.

Scales were hardly Meibom's forte, or else he would have discovered this to be Hypo-Lydian. In his notes upon Euclid he formed a set of scales so erroneously as to base the tetrachords upon the inner movable strings, instead of upon the outer, fixed sounds. Again, in his comments upon this author, he tells the reader that the two most ancient tetrachords were joined together by one string common to both, and that it was called *Hypate Mesōn*,[b] "the lowest of the middle tetrachord." Aristotle says that the string was *Mese*. It is clear that Meibom had not read Aristotle's Problems, and was guessing. In the following scales his conjectural emendations are not infrequently in the wrong places, as he might have discovered if he had drawn out a diagram of them, according to their key-notes on the lyre. The text of Aristides is undoubtedly very faulty in the copy Meibom used,[c]

[a] See p. 27.

[b] Notes on Aristides Quint., p. 209, col. 1. 6.

[c] The Harleian MS., No. 5691, of 15th century, would supply some emendations.

but still, all scales were formed according to laws about which there is no disagreement among ancient writers.

The following are the six "ancient" scales of Aristides according to the inaccurate revision of Meibom. The figure of $\frac{1}{4}$ is intended for the Enharmonic *diesis* or quarter-tone :—

CORRUPTED MIXED SCALES.

Lydian...............	$\frac{1}{4}$	2	1	$\frac{1}{4}$	$\frac{1}{4}$	2	$\frac{1}{4}$	...
Dorian...............	1	$\frac{1}{4}$	$\frac{1}{4}$	2	1	$\frac{1}{4}$	$\frac{1}{4}$	2
Phrygian...........	1	$\frac{1}{4}$	$\frac{1}{4}$	2	1	$\frac{1}{4}$	$\frac{1}{4}$	1
Iastian...............	$\frac{1}{4}$	$\frac{1}{4}$	2	$1\frac{1}{2}$	1	...	...	...
Mixo-Lydian	$\frac{1}{4}$	$\frac{1}{4}$	1	1	$\frac{1}{4}$	$\frac{1}{4}$	3	...
Syntono-Lydian ...	$\frac{1}{4}$	$\frac{1}{4}$	2	$1\frac{1}{2}$	2	...	...	...

In the above, the Dorian interval to its key-note is in its right place, as fourth of the series, according with the text. It has an ascent of two tones from the forefinger string, and its diazeuctic tone is next above it. But the Phrygian is in the wrong place. It should be on the string next above the Dorian, and so one degree to the right in the scale. Meibom added one of the above quarter-tones to fill up its Octave, so as to make it agree with another line in the text, but he ought to have placed the added quarter-tone to the left, instead of to the right, of the key-note. As it now stands, Dorian and Phrygian key-notes are on one string, which was impossible. The curious may pursue the analysis further by comparing the Greek text with

his translation at p. 21, and with the diagram at p. 22.[a] I subjoin the principal seven Enharmonic scales according to their proper order. The diagonal line from one figure of 2 to another shows the ascent to the *Mese*, or key-note of each, and its diazeuctic tone is in the next division to the right of it.

The Iastian has no place in the following, because it could only occupy the position of one of the seven scales already figured; and it was for such reasons that Claudius Ptolemy recommended the reduction of the number of scales to seven:—

TRUE ENHARMONIC SCALES.

Mixo-Lydian......	1	$\frac{1}{4}$	$\frac{1}{4}$	2	$\frac{1}{4}$	$\frac{1}{4}$	2	1
Lydian	$\frac{1}{4}$	$\frac{1}{4}$	2	$\frac{1}{4}$	$\frac{1}{4}$	2	1	$\frac{1}{4}$
Phrygian	$\frac{1}{4}$	2	$\frac{1}{4}$	$\frac{1}{4}$	2	1	$\frac{1}{4}$	$\frac{1}{4}$
Dorian	2	$\frac{1}{4}$	$\frac{1}{4}$	2	1	$\frac{1}{4}$	$\frac{1}{4}$	2
Hypo-Lydian......	$\frac{1}{4}$	$\frac{1}{4}$	2	1	$\frac{1}{4}$	$\frac{1}{4}$	2	$\frac{1}{4}$
Hypo-Phrygian...	$\frac{1}{4}$	2	1	$\frac{1}{4}$	$\frac{1}{4}$	2	$\frac{1}{4}$	$\frac{1}{4}$
Hypo-Dorian......	2	1	$\frac{1}{4}$	$\frac{1}{4}$	2	$\frac{1}{4}$	$\frac{1}{4}$	2

The value of the treatise of Aristides Quintilianus is but little affected by a slip about ancient fanciful scales, and as to a musical term which had fallen

[a] The text is very faulty, and Meibom found it necessary to interpose many intervals in order to make one part agree with another. Thus he twice changed the word "tone" into "Ditone," in the Lydian scale. Again, he added a *diesis*, or quarter-tone, to the Phrygian; the same to the Mixo-Lydian; and the final Ditone to what is called Syntono-Lydian. These alterations will be seen by comparing the Greek text at p. 21 with his Latin translation, and by his notes upon it.

into disuse at the time when he was writing. It would not be impossible, even now, to find a very learned man who could not define a musical scale of Chaucer's age, and who might, perhaps, be puzzled with one even of the time of Queen Elizabeth.

CHAPTER VII.

Greek Harmony.—Fétis's professed solution.—A passage in Plato re-considered.—Music in Greek education.—Practice of discords mixed with concords—Horace.—Seneca's description of music in an amphitheatre.—Cicero on harmony.—The modern controversy about ancient harmony.—The distinguished men engaged in it.

No subject connected with ancient music has been discussed with more earnestness, or at greater length, than as to whether the Greeks did, or did not, practise simultaneous consonances, and intermix them with discords; thus making harmony in the modern technical sense of the word.

The great discussion arose in the seventeenth century, from the discovery that the Greek word, *Harmonia,* is not a synonyme for simultaneous concordant sounds; although the world had been taught to regard it in that light, and had incorporated it into modern languages in that sense. So far the discoverers were right, for *Symphonia* is the Greek word for consonance.[a] But then, instead of pursuing the inquiry by comparing Greek definitions of *Harmonia,* some of the disputants jumped to the hasty conclusion that the word had, at no time, the sense of simultaneous consonances, but meant only "a succession of intervals, in single notes, according

[a] There are numberless definitions of *Symphōnia* and *Diaphōnia*, or concord and discord, *i.e.*, differing sounds that mix and please the ear, and sounds that grate upon it. Several have already appeared incidentally, but one more may be here cited from Euclid :—"*Ἔστι δὲ συμφωνία μὲν κρᾶσις δύο φθόγγων, ὀξυτέρου καὶ βαρυτέρου· Διαφωνία δὲ τοὐναντίον δύο φθόγγων ἀμιξία, μὴ οἵων τε κραθῆναι, ἀλλὰ τραχυνθῆναι τὴν ἀκοήν*"—(p. 8).

to their scale." Next, they defined *Melodia* as "a succession of sounds, according to time, measure, and cadence;" and, thirdly, *Symphonia* as "differing only from *Harmonia* and *Melodia* in that its *sequences* were limited to such intervals as would make up Fourths, Fifths, and Octaves; and that it did not permit any intermixture of Seconds, Thirds, Sixths, or Sevenths." So they denied simultaneous consonance even to *Symphonia*.

Thus, from a promising opening, the investigators rushed into error in the opposite extreme. If the enquiry had been pursued in the only proper way, by searching for, and comparing, Greek definitions of *Harmonia*, its meaning would inevitably have been traced to be the Theory and Practice of Music, and identical with the later word, *Harmonikē*. *Harmonia* includes poetry united with music,[a] but not poetry alone, and so it has a more restricted sense than *Mousikē*. Again, the chanting of poetry, though unregulated by musical intervals, is *Melodia*, and the metre of the poetry brings it within the denomination of *Mousikē;* but it is not *Harmonia*. So that the primary translation of the word *Harmonia* is our "Music."

The original question might, at any time, have been settled by referring to the precise explanation of *Harmonia*, by Philolaos. The only point to have been recollected was that, in the time of Philolaos, Greek science and Greek practice were limited to an Octave; and that any other Octave could be but a repetition of the first. Therefore, as Plutarch

[a] "'Αρμονία δὲ τὸ ἐκ φθόγγων καὶ διαστημάτων . . μιχθέντων δὲ τούτων, ᾠδὴ γίνεται καὶ μέλος."—(Plutarch *Comment. on Timæus*, p. 252, Reiske's edit. See also Aristides Quintilianus, p. 91. Eupolis gave to Harmonia the name of 'Αρμογή, says Pollux—(lib iv. cap. 8.)

says, Pythagoras limited the science of *Harmonia* to the sounds that are within an Octave.

The passage in Philolaos was probably passed by and neglected, on account of the difficulty of understanding its technicalities. To those who had not learned anything of Greek music, some of the words would not have been intelligible.

Although it is popularly supposed that men who undertake to write about Greek music are acquainted with some of the elementary treatises, the controversy about *Harmonia* clearly proves that many of the disputants had not thought it necessary. The passage from Philolaos might have been found, quoted by Nicomachus; and his treatise is included in the collection of Greek authors upon music, edited by Meibom, and printed in 1652. Therefore, the extract was perfectly accessible, and every one might have read it for himself.

The controversy has been carried on intermittingly for full two hundred years. In the last century English scholars engaged warmly in it, but among them, some, rather to show their powers of argument and classic lore, than from any reasonable expectation of throwing new light upon the meaning; for the Greek authors upon music had formed no part of their reading. In the present century, the discussion has been going on chiefly in France, in Belgium, and in Germany. It is not even yet concluded; for, since the harmony of the ancients must form the subject of the present chapter, it becomes necessary to controvert the strange hallucinations of the latest writer upon ancient music—F. J. Fétis, of whose *History* a third and posthumous volume has been recently announced.

The theory of Fétis was perhaps peculiar to himself. It was that the Greeks had no other simultaneous harmony than an uninterrupted succession of Fourths, a similar succession of Fifths, or a succession of Octaves.

This would bring the polished Greeks down to the barbarian level of Hucbald, in the middle ages. Such a theory is in absolute contradiction to Plato and to Aristotle—two authors whose works seem only to have entered into Fétis's reading, if at all, through the medium of translations, many of which are not remarkable for accuracy as to the musical parts of those authors. The slender peg upon which Fétis hung his extraordinary theory was not derived from any Greek author, but from two lines of Horace. Further than this, not only was the idea borrowed, but even the author was misinterpreted.

As Fétis held the high position of Director of the Conservatoire of Music in Brussels, he was looked up to as of some authority, and his fluent writings seem to have had a larger share of currency in France than those of learned French and Belgian writers. He says, in his *Biographie Universelle des Musiciens*, in which he devotes twenty-five columns to his own life, and but three and a-half to that of Auber, that he wrote the musical articles for three French journals at the same time, and often penned three criticisms in a night upon one new work, and all from different points of view. Add to the three journals the *Biographie des Musiciens*, in which he included living authors and composers, as well as the dead, and we have a formidable man; one not to be needlessly provoked by musicians who hoped for favourable report of their works, either with

their cotemporaries or with posterity. This must surely have been one reason why his extraordinary vagaries were allowed to have such free sway.

Fétis wrote upon the music of all styles and all ages, but it is only with his theories about ancient music that I have here any concern.

In Greek music, Fétis had the courage to correct Aristoxenus and other Greeks, as well as Josephus upon Hebrew words and upon Jewish musical instruments. Fétis was quite persuaded that Aristoxenus, Juba, and other great writers, did not understand Greek musical instruments, but that he, who seems not to have known the forms of the Greek letters sufficiently to look out a word in a Lexicon, could set them all right.[a] He had evidently arrived at the age when certain men consider themselves infallible — an age that has hardly been sufficiently recognised; indeed, the symptoms have not always been so strongly developed as in the late M. Fétis. We have a proverb that "young men think old men fools, but old men *know* that young men are so." For that we must have been indebted to an infallible. Fétis asserted his claims as early as 1850. He then announced in his journal that "he would give the definite solution to the difficulties before which the genius, and learning of the greatest men, such as Descartes, Leibnitz, Newton, d'Alembert, Euler, and Lagrange, had succumbed."[b]

Fétis has a new way of making Greek tetrachords.

[a] *Histoire Generale de la Musique*, i. 383 to 386. 8vo. 1869.

[b] "La solution definitive de difficultés devant lesquelles ont échoué le genie et le savoir des plus grands hommes, tels qui Descartes, Leibnitz, Newton, d'Alembert, Euler, et Lagrange." — (*Gazette Musicale*, 10 Mars. 1850. No. 10, p. 79.)

It differs wholly from that of any of the Greek authors. They all made tetrachords to consist of two tones and a half, but his are only of two tones.[a] He can only have attained to his own system by inspiration; for there has been nothing like it, either before or since. He is equally original in his teaching about the present musical scale. In writing the memoir of Boethius, ("Boèce,") he praises him for not having adopted "the false proportions of Didymus and of Ptolemy." If we grant that Fétis may be supposed to have known what he was writing about, he recommends the world to give up consonant major and minor Thirds, and to return to the discordant Thirds, or Ditones, of Pythagoras.

These are slight samples of the peculiar teaching of the author of the most recently published general history of music. His horror of mathematicians in music is sufficiently proved by the careful way in which he singles out the greatest of them for his supposed triumph. Didymus and Ptolemy were mathematicians as well as the other great men named. Fétis felt no need of mathematicians. He could, and did, write books on the theory of music, without having even troubled himself to learn the proportions of musical intervals, or the laws of natural sounds.

Fétis ascribes to the Greeks two different systems of music at different periods—one for those who

[a] His first attempt at tetrachord making was by quarter-tone, quarter-tone, and tone and half, making two tones. His second by two-thirds of a tone, two-thirds, and two thirds, (six-thirds,) also making two. His third attempt, three-quarters of a tone, one quarter, and one tone, again making only two tones, instead of two and a half."—(*Réponse à M. Fétis, et Réfutation de son Mémoire*, par A. J. H. Vincent, Membre de l'Institut, p. 21. Lille. 8vo. 1859.)

lived from the time of Pythagoras to that of Aristoxenus, when, according to him, all was plain song or "Gregorian music;" and, for those Greeks who had the good luck to be born at later dates, he allows such charms of harmony as successions of Fourths, and successions of Fifths. This uncomplimentary theory has no support from any Greek author. Fétis derived the idea that he thus harped upon from Claude Perrault, one of the numerous disputants about ancient harmony in the seventeenth century; and Perrault took his idea from misunderstanding two lines of an epode of Horace.

Sonante mixtum tibiis carmen lyra,
Hac Dorium, illis barbarum.

Fétis pursued the "illis barbarum" all round the circle, till he had proved, to his own satisfaction, that "barbarum" must mean the Mixo-Lydian mode, and that it was simultaneously employed with the Dorian, (or the keys of G and D together,) so as to make perpetual Fourths; *or else* it was Dorian and Hyper-Phrygian (D and A,) so as to make a constant succession of Fifths.

It is clear that Perrault had not read Aristotle's 19th Section of Problems, in which it is said, over and over again, that the Greeks did not sing sequences of Fourths, and did not sing successions of Fifths.[a] As to the two lines of Horace, we shall refer to them again, but will no further follow M. Fétis through his "positive solution of the difficulties

[a] In Problems xvii., xviii., xxxix. and xl. of Sect. 19, where it is either "*Αἱ δὲ ἐν τῷ διὰ πέντε καὶ διὰ τεσσάρων οὐκ ἔχουσιν οὕτως*," or, "*οὐκ ᾄδουσιν ἀντίφωνα.*" In Prob. xviii., "*Διὰ τὶ ἡ διὰ πασῶν συμφωνία ᾄδεται μόνη; μαγαδίζουσι γὰρ ταύτην, ἄλλην δὲ οὐδεμίαν.*"

before which genius and learning had succumbed," than to take one passage that he employed, through the medium of an indifferent translation of Plato, to show that it has the directly opposite meaning to that for which he employed it.

The translation adopted by Fétis was one by Victor Cousin; and, to strengthen public belief in it as an authority, he added that Cousin was assisted by Nicolo Poulo, a Greek of Smyrna, who was employed in the library of the Institut de France. Also that Poulo was "fort instruit dans la musique." Nevertheless, it does not follow that he should have understood the technicalities of ancient music, and it appears so, almost at the first word; for, where Plato recommended the lyre "*to be played in unison with the voice*," (so as to guide the learner to the right notes,) Poulo missed the sense of the word *proschorda*, which means "a string in unison." Again, to suppose that Plato could have intended "to establish symphony and antiphony between density and rarity, and between quickness and slowness," imagines some peculiar process quite unknown to the moderns. Whately says: "As muddy water is likely to be thought deeper than it is, from your not being able to see to the bottom, while water that is very clear always looks shallower than it is; so, in language, obscurity is often mistaken for depth." That seems to have formed the reliance of the translator in his rendering of this passage. It may have been a crux, because it goes a little more deeply into ancient music than the moderns have usually pursued the subject.

The following is an attempt to give the sense of the author rather than the most literal translation,

because a trifling amplification promises to render it more generally intelligible to those who have not taken up the subject of ancient music. The original and Cousin's translations are subjoined in a note.[a]

Plato says: "On this account, therefore, both the player on the Kithara and the learner ought to avail themselves of the sounds of the lyre, for the sake of the exactitude of its notes, to play in unison with the voice, note for note. But, as for playing different passages and flourishes upon the lyre, when the notes for the instrument vary from those intended for the voice—or, when close intervals of the Chromatic and Enharmonic scales are opposed to the wider intervals of the Diatonic[b]—also, when

[a] "Τούτων τοίνυν δεῖ χάριν τοῖς φθόγγοις τῆς λύρας προσχρῆσθαι, σαφηνείας ἕνεκα τῶν χορδῶν, τόν τε κιθαριστὴν καὶ τόν παιδευόμενον, ἀποδιδόντας πρόσχορδα τὰ φθέγματα τοῖς φθέγμασι · τὴν δὲ ἑτεροφωνίαν καὶ ποικιλίαν τῆς λύρας, ἄλλα μὲν μέλη τῶν χορδῶν ἱεισῶν, ἄλλα δὲ τοῦ τὴν μελῳδίαν ξυνθέντος ποιητοῦ, καὶ δὴ καὶ πυκνότητα μανότητι, καὶ τάχος βραδύτητι, καὶ ὀξύτητα βαρύτητι ξύμφωνον καὶ ἀντίφωνον παρεχομένους, καὶ τῶν ῥυθμῶν ὡσαύτως παντοδαπὰ ποικίλματα προσαρμόττοντας τοῖσι φθόγγοις τῆς λύρας · πάντα οὖν τὰ τοιαῦτα μὴ προσφέρειν τοῖς μέλλουσιν ἐν τρισὶν ἔτεσι τὸ τῆς μουσικῆς χρήσιμον ἐκλήψεσθαι διὰ τάχους · τὰ γὰρ ἐνάντια ἄλληλα ταράττοντα δυσμαθίαν παρέχει."—(Plato *De Legg.*, lib. vii. cap. 16, or H, Stephens, 812, D.) "C'est donc dans la même vue que le maître de lyre et son élève doivent jouer de cet instrument, à la cause de la netteté du son des cordes, et en se contentant de rendre fidèlement les sons marqués par le compositeur. Quant aux variations sur la lyre, lorsque la lyre exécute certains traits que ne sont pas dans la composition, qu'on établit la symphonie et l'antiphonie entre la densité et la rareté, la vitesse et la lenteur, l'aigu et le grave, et qu'on arrange ainsi sur la lyre toute sorte de variations rhythmiques, il n'est pas besoin d'exercer à toutes ces finesses des enfants qui n'ont que trois ans pour apprendre," &c.—(Fétis *Memoire sur l'Harmonie simultanée*, &c., p. 12, 4to, Brussels, 1859, quoting *Œuvres de Platon*, traduites par Victor Cousin, *Les Lois*, liv. vii. p. 59.)

[b] Here, in the two words, *πυκνότητα μανότητι*, Plato compresses much substance. Three strings out of the four of every tetrachord in the Chromatic and in the Enharmonic scales, being brought closely together, were at compressed intervals, therefore were *puknoi*. By lowering the forefinger string in these scales, there remained but the intervals of two semitones between the lowest three strings in the

there are quick to slow, or high to low notes, thus making varied harmony, or running together in Octaves. And in like manner, as to adapting the manifold diversities of rhythm to the notes of the lyre, it is unnecessary that all these things should be learned by those who have to acquire a serviceable knowledge of the art and science of music within three years, on account of the speed that is demanded—for opposite principles, confusing one another, cause slowness in learning."[a]

Three years would not have been required only to learn to accompany the voice in unison with the lyre. That was but one branch of *Harmonia*, and *Harmonia* itself but one branch of that *Mousikē*, from which we have taken the word "Music," through the Latin *Musica*. *Mousikē* was reputed by the Greeks to be the "encyclopædia of learning."[b]

Although, in the course of general education, boys were only taught so far as to play in unison with the voice, the Greeks practised every variety of vocal accompaniment. Aristotle's opinion was

Chromatic, and but of two quarter-tones in the Enharmonic. Then the lowest strings of all, in each tetrachord, were called *barupuknoi*, the next above them *mesopuknoi*, and the forefinger strings, *oxupuknoi*.—(See Euclid, pp. 6, 7, 14.) *Ἴδιον δὲ ἐστι τοῦ μὲν ἐναρμονίου καὶ τοῦ χρωματικοῦ τὸ καλοῦμενον πυκνόν.* — (Ptolemy, p. 30, fol.) So Plato includes those two systems in one word. There were no *puknoi* in Diatonic scales. —(Euclid, p. 14.) The definition of *puknotēs* was when the forefinger string was so lowered that the interval between the three lowest of the tetrachord was less than between the forefinger and the one highest. — (Aristoxenus, p. 50.) *Manotēs*, on the contrary, refers to scantiness of notes, through the width of the intervals, and includes Diatonic scales, as opposed to Chromatic and Enharmonic. The short sense of the two Greek words, *πυκνότητα μανότητι*, is "close intervals against wide ones."

[a] The late Dean Alford also mistook the meaning of this passage. See his article upon Ancient Greek Music in the Philological Museum, vol. ii. p. 437.

[b] "*Μουσικὴν τὴν ἐγκύκλιον παιδείαν φήσι.*"—(Scholiast on lines 188 and 189 in *The Knights of Aristophanes.*)

that "*all* consonances are more pleasing than simple sounds," and he justly adds that "the sweetest of consonances is the Octave."[a] His estimate of the Octave has been fully shared by the moderns; for, the sets of variations upon an air, so much in favour some years ago, would have been thought incomplete if there had not been one among them specially devoted to playing passages in Octaves. Greek ears, and those of the moderns, again coincide in forbidding the playing of Fourths or Fifths in sequences, and in only allowing them to be intermixed with other intervals.

The development of harmony was much less favoured by the national instrument of the Greeks than it is by those of the moderns. The lyre was made to serve the triple purposes of the rhapsodist, of the orator, and of the musician. Orators now speak without the accompaniment of music, and every house is furnished with a less portable, but more complete, musical instrument than the lyre.

Plato, Plutarch, and some others of the ancients, valued music more highly for educational than for any other purpose, and, desiring to make the knowledge universal, they advocated a return to the ancient simplicity of style. Plato would have banished from his model republic all musical instruments that had an extensive compass of notes. He objected to flutes as having too many sounds.[b]

Plutarch commended the ancient Nomes of

[a] "*Συμφωνία δὲ πᾶσα ἡδίων ἁπλοῦ φθόγγου, καὶ τούτων ἡ διὰ πασῶν ἡδίστη.*"—(Prob. xxxix. of Sect. 19.)

[b] *Πολυχορδότατον* is the word —(*Repub.*, lib. iii. 399 d). *χορδή* means not only a string, but also a sound such as a string would produce. It is made evident here, (as it is elsewhere,) for flutes could have no strings. Again, a tetrachord means four sounds quite as often as four strings.

Olympus, which were upon three notes; and he expressed his regret that the limitation of melodies to the compass of a few sounds had become obsolete in his own time.[a] Yet the instrumental accompaniments played by the very ancients to whom he refers were certainly compounded of concords mixed with occasional discords; for he states that, in the strict spondæan mode, they played such notes as D, in "dissonance" with C, or B,[b] and in "harmony" with A or G.[c] In these were the passing discords of one tone against the next; of the minor Third (esteemed a discord on account of the imperfect tuning), and the concords of the Fourth, and of the Fifth. In spite, however, of his advocacy of limit to the number of notes, Plutarch admitted music to be also "a suitable attendant on conviviality; and, in his judgment, the art is never more beneficial than in seasons of festive relaxation and indulgence." He thought, too, that music has "the power of allaying the stimulating effects of wine"—(cap. *ult.*).

Many more proofs of the employment of harmony might be derived from Plutarch's Dialogue on Music —as when he states that the reason assigned for the exclusive use of the ordinary Diatonic and Chromatic scales in his own time, and for the rejection of all such refinements as Chromatic thirds, and Enharmonic quarters, of tones, was the inapplicability of such minute divisions for harmony (cap. 38); and again, in his references to Plato and to Aristotle (caps. 22 and 23).

[a] *De Musica*, cap. 12.

[b] Burette said "against B flat," instead of B natural, but he forgot that there was no *Paramese* in the Synemmenon tetrachord in Plutarch's time, and even for ages before it.

[c] *De Musica*, cap. 19.

Aristotle speaks of playing *Mese* and singing *Paramese; i.e.*, striking the key-note and singing the tone above it[a]—necessarily a discord. Plato, in the preceding quotation, alluded to playing or singing one of the small intervals of the Chromatic or Enharmonic scale against the Diatonic. In both cases those would be discords, made, as we commonly do, in passing from one interval to another. Gaudentius describes *Paraphōnes* as holding a middle place between consonances and dissonances, but as sounding like consonances "when played together upon an instrument."[b] He classes Ditones and Tritones among them. (He is the only Greek author who includes Tritones.) Plutarch speaks of a practice among the lyrists, in his time, of altering the tuning of the lyre, and of invariably flattening the forefinger strings.[c] This is strong testimony to the goodness of their ears. The object was, no doubt, to get rid of the Fourth and minor Seventh, and so to make better melody with other parts of the scale. He adds, that they lowered the fixed sounds to suit this system.[d]

Athenæus quotes Phænias the Peripatetic, one of the immediate disciples of Aristotle, as saying, in book ii. of his *Treatise on Poets*, that "Stratonicus, the Athenian, was the first person reputed to have introduced full chords in simple harp-playing, (without the voice,) and that he was the first who took pupils in music, and who composed diagrams of music;"[e]

[a] Prob. xii. of Sect. 19.

[b] "Ἐν δὲ τῇ κρούσει φαινόμενοι σύμφωνοι."—(p. 11.)

[c] *De Musica*, cap. 39.

[d] Intervals foreign to a scale were termed *aloga*, or, "without ratio."

[e] "Δοκεῖ τὴν πολυχορδίαν εἰς τὴν ψιλὴν κιθάρισιν πρῶτος εἰσενεγκεῖν, καὶ πρῶτος μαθητὰς τῶν ἁρμονικῶν ἔλαβε, καὶ διάγραμμα συνεστήσατο."—(Lib. viii. Sect. 46.)

perhaps meaning that he was the first who wrote down his compositions upon wood or papyrus. The credit of having been the first instrumentalist is, however, disputed by others.[a] Harmony is implied in the one fact of Stratonicus having played chords upon his instrument. Again, the Epigoneion was an instrument of the harp kind, with forty strings; and even if it had but half that number, some of them could only have been useful for harmony, as the voice would very rarely extend beyond fifteen notes. "Although the Epigoneion is now transformed in the upright psaltery," says Athenæus, "it still preserves the name of the man who was the first to use it. Epigonus was by birth an Ambraciot, but he was subsequently made a citizen of Sicyon, and he was a man of great skill in music, so that he played with his hands, without a plectrum; for the Alexandrians have great skill in all the above-named instruments, and in all kinds of flutes."[b] This quotation is another evidence that the Egyptian custom of playing instruments of the harp kind with both hands had extended, at an early date, from Alexandria to Greece. Again, to Epigonus is attributed, on the authority of Philochorus, that he was the first who introduced duets between harp and flute, and who instituted a chorus.[c]

Several passages from Latin authors have also been brought into the discussion about ancient harmony, and among them the ninth epode of Horace, before referred to. Horace proposes to celebrate the victory of Actium with Mæcenas, at his villa, "the song with the lyre being intermingled

[a] See Athenæus, lib. xiv. cap. 42.

[b] Athenæus, lib. iv. cap. 81.

[c] Athenæus, lib. xiv. cap. 42.

with flutes—a Dorian strain on the one side, and for those yonder, Phrygian—or some other."[a]

Sober and manly Dorian might have suited the tastes of Mæcenas and of Horace, but there were others, Horace thought, who would prefer something more lively, more enthusiastic, bacchic, or even erotic —for such a joyous celebration.

It seems almost needless to remark upon this passage that the "intermingling" is of the voice, the lyre, and the flutes, and not of the Dorian and Phrygian songs, which are sufficiently kept apart by the words "hac" and "illis." Yet the Fétis theory was built upon a directly opposite construction. He omitted, however, to elucidate one part of his system, viz., how he proposed that the words, the rhythm, and the time, of two songs of opposite character were to be made to harmonize together. Something more than a succession of Fourths and Fifths was required for that purpose. Yet it was upon this passage that he built up an imaginary system of music for the Greeks, and as it was his only proof, he was under the necessity of coupling together "les Grecs et les Romains," in the title of his book.[b]

While on the subject of the Romans, there is a passage in the 84th Epistle of Seneca, that was long after borrowed from him by Macrobius,[c] and which refers both to the ancient chorus, and to harmony, while it gives a curious picture of music at the

[a] "Sonante mixtum tibiis carmen lyra—
Hac Dorium, illis barbarum."

[b] *Mémoire sur l'Harmonie simultanée des Sons, chez les Grecs et les Romains.* — (pp. 16 to 36. 4to. 1859.)

[c] *Saturnaliorum Conviviorum Proem.* Macrobius abbreviates Seneca in this fashion:—"*Ita* singulorum *illic* latent voces, omnium apparent . . . *et* fit concentus ex dissonis."

public celebrations of Imperial Rome.[a] It begins thus :—

"Do you not observe of how many persons' voices a chorus consists? and yet but one sound is produced from all. One has a high voice, another low, a third a middle voice; the tones of women are added to those of men; flutes are intermingled. No single voice is distinguishable; it is heard only as a portion of the whole. I am speaking of the chorus with which the ancient philosophers were acquainted; for, in our public celebrations, there are more singers than there were formerly spectators in the theatre. When our array of singers has filled up every passage between the seats in the amphitheatre—when the audience part is girt round by trumpeters, and all kinds of pipes and other instruments have sounded in concert from the stage—out of these differing sounds is harmony produced. Thus would I have it with our minds."

Another allusion to harmony is found in his 88th Epistle,[b] which is on the subject of consolation in adversity. He there says :—

"And now to music—you teach how voices high and low make harmony together—how concord may

[a] "Non vides, quam multorum vocibus chorus constet, unus tamen ex omnibus sonus redditur. Aliqua illic acuta est, aliqua gravis, aliqua media. Accedùnt viris feminæ, interponuntur tibiæ. Singulorum ibi latent voces, omnium apparent. De choro, dico, quem veteres philosophi noverant. In commissionibus nostris plus cantorum est quam in theatris olim spectatorum fuit: quum omnes vias ordo canentium implevit, et cavea æneatoribus cincta est, et ex pulpito omne tibiarum genus organorumque consonuit, fit concentus ex dissonis. Talem animum esse nostrum volo."

[b] "Ad musicam transeo. Doces me quomodo inter se acutæ et graves voces consonent, quomodo nervorum disparum reddentium sonum fiat concordia: fac potius quomodo animus meus secum consonet, nec consilia mea discrepent. Monstras mihi qui sunt modi flebiles: monstra potius, quomodo inter adversa non emittam flebilem vocem."

arise from strings of varying sounds—teach, rather, how my mind may be in concord with itself, and my thoughts be free from discord. You point out modes fittest for mournful strains, but, in my adversity, show rather how I may restrain the utterance of any mournful note."

There is another equally unequivocal passage from Cicero, relating to music in parts, which will be found in the second book of his *Republic*:—

"For, as in strings or pipes, or in vocal music, a certain consonance is to be maintained out of different sounds, which, if changed or made discrepant, educated ears cannot endure; and as this consonance, arising from the control of dissimilar voices, is yet proved to be concordant and agreeing—so, out of the highest, the lowest, the middle, and the intermediate orders of men, as in sounds, the state becomes of accord through the controlled relation, and by the agreement of dissimilar ranks; and that which, in music, is by musicians called harmony, the same is concord in a state."[a]

Cicero's mere definition of the word *concentus*, in his *Republic*, ought to have been enough to prove the whole case:—"Hic [sonus] qui . . . acuta cum gravibus temperans varios æquabiliter concentus efficit." (*Rep.*, vi. 18.) Again, if any of the disputants had read Section 19 of Aristotle's Problems, and especially

[a] "Ut enim in fidibus aut tibiis, atque ut in cantu ipso ac vocibus, concentus est quidam tenendus ex distinctis sonis, quem immutatum aut discrepantem aures eruditæ ferre non possunt; isque concentus, ex dissimillimarum vocum moderatione, concors tamen efficitur, et congruens. Sic ex summis, et infimis, et mediis, et interjectis ordinibus, *ut sonis*, moderata ratione civitas, consensu dissimillimorum, concinit; et quæ harmonia a musicis dicitur in cantu, ea est in civitate concordia."—(Cicero *De Repub.*, lib. ii. cap. 42, vol. v., p. 283, edit. Bouillet. 1831. 8vo.)

No. 39, in which he says that "all concordant sounds are more agreeable than single notes, and that of concords the Octave is the most agreeable," that ought to have sufficed to prove the Greek case. But, in truth, floating upon the surface of music has been for ages more popular than diving.

It is now curious to look back upon the ardent discussions about the harmony, or the no-harmony, of the ancients, and to read the number of distinguished names among those who took part in them.

Dr. Burney devotes nearly forty pages of his *History of Music* to a dissertation upon this subject, and concludes with his own summing up, which is not the least curious part.

The following is the catalogue of names from his eighth Section of vol. i. It does not include those who enlisted, or were drawn into the discussion after 1776, neither does it affect to be complete as to those who preceded that date :—

French. — Charles Perrault, Claude Perrault, Boileau, Racine, La Bruyère, Fontenelle, Abbé Fraguier, Abbé Roussier, Mersenne, Burette, Chateauneuf, de Chabanon, Father Boujeant, Father Cerceau, and Jean Jacques Rousseau.

Italians. — Franchinus Gaffurius, Glareanus, Marsilius Ficinus, Zarlino, Vincenzo Galilei, G. B. Doni, Zaccharia Tevo, Bottrigari, Artusi, Tartini, Bontempi, and Padre Martini.

Spaniards.—Salinas and Cerone.

Germans and Hollanders.—Kepler, Athanasius Kircher, Isaac Vossius, Meibomius, and Marpurg.

English.—Dr. John Wallis, the mathematician ; Sir Isaac Newton, Sir William Temple, Wooton, Boyle, Dr. Bentley, Swift (in *The Battle of the*

Books), Stillingfleet, Mason, Dr. Jortin, and, lastly, Dr. Burney.

There would be no difficulty in adding largely to Dr. Burney's list, but it suffices to show the great interest formerly taken in this subject. In his summing up, Dr. Burney adopted an erroneous definition of "The Harmony of the Ancients," from Mason,[a] and in translating Aristotle, he missed the distinction between the Greek *Sumphōna* and *Antiphōna*.[b]

In the history of literature there is perhaps no one thing more singular than that, with the number of learned men of all ages, and of all nations, who have enquired into the history of ancient music, no one of them should ever have thought of making an adequate investigation as to the meaning of the every-day words, which have been incorporated into modern languages through the Latin. In some, the cause may have been implicit faith in all Church usages and traditions; but that alone is an insufficient excuse; and yet, to what other cause are we to attribute it? One thing is certain—it is mainly owing to that lack of enquiry that Greek

[a] Mason's definition is "The *succession* of simple sounds, according to their scale, with respect to acuteness and gravity."—(Burney's *History*, i. 125.) How was it that Dr. Burney did not encounter something nearer to the truth than the above? Even without troubling himself to look to primary sources for information, in Vossius's *De Poematum Cantu*, he might have found the following quotation ready to hand:—"Συμφωνία δὲ ἐστι δυοῖν ἢ πλειόνων φθόγγων ὀξύτητι καὶ βαρύτητι διαφερόντων κατὰ τὸ αὐτὸ πτῶσις καὶ κρᾶσις."—(p. 82. Oxford. 8vo. 1673.)

[b] He translates Aristotle thus:—"*Neither the Fifth nor Fourth,* though concords, *were sung together in concert*"—(i. 137). Instead of "in concert"—he should have written "in successions," or, "not as *antiphōns*." By translating "in concert," he has made Aristotle contradict himself and every other Greek writer. It must have been Dr. Burney's misunderstanding of the word *antiphōn* that led him to accept Mason's definition.

music has so long remained a mystery, and that passages relating to music in classical authors have been so long misunderstood.

There are no extant specimens of ancient Greek or Roman harmony, but there remain three of Greek hymnal melody, which will form the subject of the next chapter.

CHAPTER VIII.

Three Greek hymns with music.—Assistance to learning rendered by illustrious Oxonians.—The three hymns the only trustworthy remains of Greek music.—Not duly represented hitherto.—Reasons given.—Now published in modern notation.

VINCENZO GALILEI, father of the great astronomer and mathematician, Galileo Galilei, was the first to publish three ancient Greek hymns with their music, in his *Dialogo della Musica Antica e Moderna*, at Florence, in 1581. They were copied from a Greek manuscript that was then in the library of Cardinal St. Angelo, at Rome.

A second Greek manuscript, which included the same hymns, was found among the papers of Archbishop Usher, in Ireland, after his decease, and was bought by Bernard, a Fellow of St. John's College, who took it to Oxford. The hymns were printed from that manuscript, under the editorship of the Rev. Edward Chilmead of Christ Church, at the end of the Greek edition of the astronomical poems of Aratus, published by the University in 1672.

During the seventeenth century there was great earnestness among the learned at Oxford in reviving ancient Greek literature, including that of music. When Mark Meibom, or Meybaum, (in Latin, Meibomius,) undertook to edit a collection of the works of Greek authors upon music, and to publish them at Antwerp, he received most hearty encouragement and assistance from eminent members of the University, and particularly from Selden, from

Patrick Young (who had been librarian to James I. and Charles I.,) and from Gerard Langbaine, Provost of Queen's College, and keeper of the Archives of the University. They lent, or procured for him, the loan of valuable Greek manuscripts from private libraries, and both Selden and Gerard Langbaine copied and compared transcripts; the latter collating with the best of the numerous Greek manuscripts in the libraries of the University. Chilmead gave up his prepared edition of Gaudentius in Meibom's favour, and all concurred in promoting and in giving publicity to his work. Many copies must have been bought in England, for no books upon ancient music have been more commonly found in private libraries, when sold by auction, than the *Antiquæ Musicæ Auctores Septem.* Nevertheless, for want of sufficiently general encouragement, and, as Dr. Wallis adds, ("propter rem angustam domi,") scarcity of means, Meibom found himself unable to carry the series further. Then Dr. John Wallis, who was Savilian Professor of Geometry in the University, included the remaining unpublished treatises of Claudius Ptolemy, of Porphyry, and of Bryennius, with his own works, (giving the Greek texts with Latin translations, and with large and useful comments upon them,) and these were published by the University in 1693-99. It may therefore be said that, within that half century, Oxford did more towards advancing the knowledge of this most ancient music than has been accomplished by any University in Europe, whether before or after.

In 1720, M. Burette found a third manuscript containing these hymns, in the King of France's library at Paris, No. 3221, and he reprinted them in

the fifth volume of *Mémoires de l'Académie des Inscriptions*, 1720.

The Florentine edition agrees with that of Oxford, but the French edition adds six introductory lines, without music, to the Hymn to Apollo, and supplies three or four missing notes.

These hymns are the only trustworthy remains of ancient Greek music; for although the first eight verses of the first Pythian of Pindar were printed by Athanasius Kircher in his *Musurgia*, in 1650, and were asserted to have been discovered by him in the famous Sicilian library of the Monastery of St. Saviour, near the port of Messina, he was by far too imaginative ever to be followed with safety, and especially in this case. Although every possible search was made for the aforesaid manuscript soon after his announcement, and all the manuscripts in the Monastery were catalogued, this could never be found.

The *Te Deum Laudamus* that Meibomius printed at the commencement of his *Antiquæ Musicæ Auctores*, and which Sir John Hawkins mistook for an ancient copy,[a] was but an exercise of Meibom's ingenuity in turning Church Plain Song into Greek musical notation, just to show how it would look; and as it was then the custom in Germany to sing the B flat in the *Te Deum*, although the flat was not marked in the Plain Song, he adopted the Greek sign for B flat, but left that note natural in the ecclesiastical notation. For the understanding of English readers there should be one flat at the signature, so as to make it correspond with his Greek music.[b]

[a] Hawkins's *History*, i. p. 49. 4to.

[b] Meibom has given wrong Greek characters for the note C on the syllable "Sal" in "Salvum fac populum tuum." He there turned to the wrong scale.

The first of the three ancient Greek hymns is to the Muse Calliope, and it includes an address to Apollo, as leader of the Muses. The second is a hymn of greater length, addressed to Apollo, and the third, which is imperfect as to music, is dedicated to Nemesis. No fair estimate of the former state of music in any country can be adequately formed from the remains of its hymns. Sacred music has always been in arrear of the secular, and no one would suppose that a piece of ordinary hymnal music of the present century would fairly represent the present state of music in Europe, although such a specimen might, by some similar chance, survive for many centuries to come. Yet even these hymns throw some light upon the ancient state of the art.

Before Burette's time they were printed as Plain Chant, without any attempt at timing the notes. He was the first who reduced them according to length of syllables, and barred them so; and after him, Dr. Burney, and others. The plan they adopted was to mark every long vowel, or syllable, by a minim, and every short one by a crotchet. As the metre was often irregular, this arrangement threw them out of rhythm, and it may be objected that it was not the system that should have been adopted to represent ancient music fairly in modern notation. In the time of the Ptolemies, the Alexandrian grammarians discovered that the poems of Homer included a large number of irregular lines,[a] which they then set themselves to rectify; but those irregularities were held to be sufficiently accounted for and excused, because the poems were

[a] Athenæus, lib. xiv. cap. 32.

written for chanting, and were intended always to be rhapsodised, or chanted. In music, it is not necessary that the exact syllabic reading-length of words should be adhered to. It would thereby be deprived of all variety, and become monotonous in the extreme. Music has the power both of prolonging and of shortening the duration of words, and thereby of covering irregularities in metre. For instance, we chant the *Te Deum*, the *Jubilate*, and the Psalms rhythmically as to music, although written as prose. Rhythm is the parent of melody, and even savages beat regular time to their songs. How much more then must rhythm have been an essential part of Greek music, when it was from the Greeks that the laws of rhythm were derived!

Burette's copy is now but little in the hands of English readers, therefore further remarks, although of general application, may be limited to Dr. Burney's later version, which is in the same style as that of Burette.—(*History*, i. 86, *et seq.*)

First, as to the imaginary difficulties in adding a base to the music of these hymns. Dr. Burney says:—"Upon the whole, these melodies are so little susceptible of harmony, or the accompaniment of many parts, that it would be even difficult to make a tolerable base to any one of them, especially the first."—(i. 97.)

Seeing no sufficient reason for this comment, I selected this first of the hymns to have a base added to it. My learned and kind friend, Professor G. A. Macfarren, of the Royal Academy of Music, has obligingly contributed two kinds of harmony—one in the Greek view of the key, and one in the modern. So the reader will now judge for himself

how far Dr. Burney was from the mark when he spoke of the insusceptibility of these Greek hymns for harmony.

Dr. Burney printed all three in the key of F sharp minor, because, says he, "It was discovered that these hymns were sung in the Lydian mode of the Diatonic genus, by comparing the notes with those given by Alypius."—(i. 95.) That all the notes are to be found in the Lydian mode is undoubtedly correct, but a little further comparison would have shown that they are equally to be found in the Hypo-Lydian mode, with C ♯ as *Mese*. The one note that a modern musician might not expect to find in the key is "d" natural in the upper Octave, but it is essential to the Conjunct, or Synemmenon, tetrachord of that mode. Therefore the question between the modes has to be determined by Aristotle's law—which of the two notes, F sharp or C sharp, more nearly complies with the required conditions, as the *Mese* in question? In that view there can hardly be a doubt but that C sharp, and not F sharp, is the nominal *Mese*. So the hymn is to be taken in the usual hymnal scale of the Lesser Perfect System, with a semitone, instead of a tone, above that string.

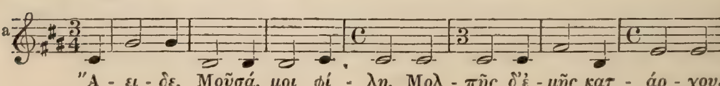
The particular use of the semitone above the key-note, (as of this "d" natural in a mode having C sharp as *Mese*,) was that it enabled the player to modulate from the Hypo to its parent key, as here from Hypo-Lydian to Lydian, the latter being a Fourth higher. If we look back to the tuning of Terpander's seven-stringed lyre, and of Ion's ten strings, we may find the same semitone above *Mese*, and so the three scales, Terpander's, Ion's, and this, may

fairly be said to establish the long continuance of this ancient and favourite hymnal modulation. Herein, too, we trace the origin of the "b flat" above "a" in the Plain Chant of the Western Church; and how, in its most ancient form, it allowed of the modulation from Hypo-Dorian to Dorian. If it were but for this one hitherto unnoticed link between the two, these hymns would be of considerable historical interest.

Another point to be observed is that, even in the seventh century B.C., Terpander had exactly the same number, and the same series, of notes down from his key-note as in these hymns, although he had but a Fourth above it, whereas the hymns extend to the Sixth, and one to the minor Seventh.

The lyre for the hymns was perhaps one of ten strings, since the compass of the voice-part does not exceed ten notes. The *Mese* of the Hypo-Lydian mode is the tenor "c" sharp, that is, one ledger line above the base staff and one ledger line below the treble. The vocal compass extends to a Fourth below it, viz., to G sharp, and rises upwards to "a," the minor Sixth, and, in the Hymn to Nemesis, to "b," the minor Seventh.

In writing out the Hymn to Calliope according to the strict quantity of syllables, the metre being irregular, Dr. Burney adopted the system of making four changes of time, from triple to common, and *vice versâ*, within the first line of the music.[a] He included two lines of poetry within these seven bars, and began the eighth bar with a rest.

[a]


—(vol. i. p. 86.)

It would have puzzled any *chorodidáskalos*, or Dr. Burney himself, to have kept singers in time with such interruptions of rhythm. It is strange that he should have printed it so, after having remarked but a few pages before that Greek music was "all rhythm."[a] "The time of notes," says Gaudentius,[b] "is to be ruled by the rhythm of the poetry." There is not a shade of probability that the hymn can have been intended to be sung in the hobbling, unrhythmical style adopted by Burney. Even if it had been desired to throw ridicule upon ancient music, as one way of disposing of a troublesome subject, no more effectual means could have been adopted.

The hymn is described in the text as "irregular iambic" (*Iambos Bákcheios*), and the irregularity begins with the second line. The first is what was called *Dimeter*, or "Two Measure" iambic, consisting of four poetic "feet." This was formerly called "Minstrel Measure" in England.[c]

Ă | eīdĕ, Moūsă, | moī phĭlē.

The iambus is a poetic foot having the first syllable short and the second long. The spondee has two long syllables.

In irregular metres, the law which overrules the

[a] In vol. i., p. 66, of his *History of Music*, Burney says :—"What a noisy and barbarous music! all *rhythm* and no sound." This is a strange comment upon the employment of the foot, the hand, of oyster shells, or of bones, only employed to beat time. Have not castanets, tambourines, drums, and cymbals been used in modern times for the same purpose? They all mark the rhythm, but do not constitute the music.

[b] Gaudentius, p. 3, edit. Meibom.

[c] It might, perhaps, with equal justice have been named "Sternhold and Hopkins' measure;" still four iambics are by no means uncommon metre for lyric poets. In music, they would be barred from the down beat, or strong accent, thus:—

"Dĕs | cēnd, yĕ nīne, dĕs | cēnd ănd sīng,
Thĕ | brēathĭng īnstrŭ | mēnts ĭnspīre."

strict timing of syllables is the Measure of the verse. A Measure consists of two poetic feet, which are not necessarily of the same kind, and is the equivalent to the bar in music. The one difference between the two is that the bar of music begins on the *thesis*, or down beat, which is the stronger accent. That order was once reversed for dancing, as the *arsis*, or up-spring, was the strong one that began the movement; whereas, in beating time with the hand, as for music, the strong beat is downwards, and the *arsis* is weak. In the case of iambic verse, or other beginning with a weak syllable, *i.e.*, with the *arsis*, or up-beat, that syllable is placed before the bar. So the music has the appearance of the reverse of iambic, viz., of trochaic, or the first syllable long and the second short. The length of irregular syllabic quantities has to subserve and to be fitted into the *arsis* and *thesis*, or up and down beats of the foot of verse, in the measure that has been adopted. Instead, then, of such constant changes of time as those adopted by Dr. Burney, which make equally constant changes of the rhythm, one rhythm should have been preserved. The syllables should have been brought into the beats of the bar, in the best way the sense would permit, and with all the regard that could be paid to relative quantities. Proportion may be preserved when exact length cannot—it is but as quicker or slower speaking.

Thus verse and music will go together. When the same number of beats can be brought into each line of a poem, or into corresponding lines of stanzas, there should be no difficulty in writing out the music. A musician will be further guided in this by the notes themselves, which often indicate to him the author's design. Therefore in a musical system

so identical with our own as is the Greek, Dr. Burney could have been one of the best interpreters if he would have thought more of musical rhythm and less of the equal duration of syllables.[a] In the state in which the hymns have hitherto been presented to readers, it is doubtful whether any one can have noticed a single phrase of tune in any one of them. Those phrases of tune are now brought out.

There are so many cases in which music is to be found in old timeless notes, but written over poetry, which gives the measure, that many a fine old melody may yet be rescued from oblivion by a musician who will adopt this course.[b] In the hymns as now printed, there has been little change from Burney's copy as to notes, but much in their time, in order to preserve rhythm.

Anciently, the Long and the Breve in music were equivalent in duration to the long and the short syllable in recitation, and they took their names from the long and short syllables. But the system of musical notation has been changing century after century in

[a] Dr. Burney has measured the syllables in the opening of the Hecuba of Euripides, and has given them a comical appearance by timing them in the same fashion as the hymns.—(i. 72.) They are in trimeter, or six feet, iambic, which was employed in the dialogue of Greek tragedies, and required that the second, fourth, and sixth feet should be iambics, leaving the others to be filled up so as to give variety. Greek plays are not to be rated like modern operas, in which every syllable is set to varied music and timed. They were to be chanted, and in chanting, greater license than this might have been well permitted. As with iambic, so with trochaic metre, except that the first, third, and fifth were to be trochees, instead of second, fourth, and sixth, and the rest might be varied. Perpetual trochees, or perpetual iambics, without even stops, would have been too monotonous for ears to bear for any long time.

[b] This was the course I pursued in copying out ancient English songs from manuscripts, and it was often proved to be right by the fact that the airs were in many cases country-dance, as well as ballad, tunes. To be dance tunes they must have been strictly rhythmical.

favour of notes that will occupy less space, that can be more rapidly written, and that can be tied together so as to form a guide for the eye at one glance as to the duration of several notes; until at last, the crotchet and quaver, or even the quaver and semiquaver, now represent the long and short syllable of ancient times. I therefore recommend that the notes be first copied over the words as crotchets, and that the precise time of the former be determined afterwards. Then that the line of poetry be divided into two, by scanning, or by the ictus,[a] or accents in reading,[b] and a bar drawn to the music before the down-beat of the second half. This one bar is a sufficient division for short metres, as in the first Greek hymn, but in the case of longer lines, or of triple time, the lines may require to be further divided. Then let the notes be timed within those bars according to the reading of the words, and as the phrases of music appear to require. If some of the accents should fall badly, there are still parallel cases in modern music. With such care there seems but little probability of material variation from the original design, and it is perhaps the only way of arriving at it. To bar music by accents is a comparatively modern practice. When bars were first introduced, they were mere measures of time, therefore old barring is not to be followed implicitly.

[a] "The structure of verse is such a division of each line by the words comprising it as form a movement most agreeable to the ear." — (*Theatre of the Greeks*, by J. W. Donaldson, D.D. p. 37.)

[b] Not by the three Greek accents of printed books, for the grave and acute accents in ancient Greek were but what their names indicate, viz., marks for the rise and fall of the voice, or pronunciation marks. The Greeks had other accents for quantity, also called *προσῳδίαι*, of which hereafter. The practice of giving quantity to the grave and acute accents in modern Europe differs from ancient Greek use.

In the Hymn to Calliope, the first word of the second line is marked "*spon*," for "spondee," or for two spondees, in the line. The two long syllables of a spondee cannot be brought into iambic metre, but iambics can be brought into spondaic or common time, by adding on to the long syllable, or by a pause between each foot. There are several other lines in the hymn which equally require to be in common time. Thus the iambics must become "irregular," as they are said to be. The long, or accented syllable, using the word "accented" in the *modern* sense of giving quantity, may be further lengthened by a dot or rest, as required in Greek verse for a *katalēxis* to make up the time, or both syllables may be proportionably shortened, according to the necessities of metre.

The music of the hymns is included in five more manuscripts than were known to Burney. Fac-similes of them were printed in Berlin in 1840, by Dr. F. Bellermann, who added a collated text. From this, Bellermann corrected several wrong notes in earlier printed versions. A few notes are deficient in all manuscripts, and they are here supplied in smaller type.

Greek hymns were a tranquil kind of music, "emblematic of a mind at ease." There was no *gehenna* in the creed of the heathen to disturb their equanimity. "Every banqueting party was subjected to a god; and, accordingly, men wore garlands appropriated to the gods, and greeted them with hymns and odes.[a] Thus, Greeks and Romans emulated the Egyptian ladies, seen at p. 63, in making religion a subject of cheerfulness and festivity.

[a] Athenæus, lib. v. cap. 19, p. 192.

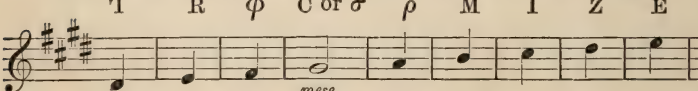
The following Hymn to Calliope is printed in the Hypo-Lydian mode, as transposed a Fourth lower by Claudius Ptolemy, in order to bring it within the reach of ordinary voices. So G sharp is the Mese, distinguished by the A natural above it. At the old pitch, C sharp would have taken the place of G sharp, and the voice part would have ranged up to *a*, which requires a high tenor voice :—

ΕΙΣ ΜΟΥΣΑΝ. Ἴαμβος Βάκχειος.

σ Z Z φ φ φ σ σ Ἄειδε, Μοῦσά, μοι φίλη,	Sing, O Muse, dear to me;
σπον ϊ φ M M Μολπῆς δ' ἐμῆς κατάρχου,	My song lead thou:
Z Z Z E Z Z ϊ ϊ Αὔρη δὲ σῶν απ' ἀλσέων	Let the air of thy groves
M Z φ σ ρ Mφ σ 'Εμὰς φρένας δονείτω·	Excite my mind;
σ ρ M ρ σ φ σ Καλλιόπεια σοφὰ,	Calliope, skilled in art,
φ σ σ σ σ σ ᒣ R φ Μουσῶν προκαθαγέτι τερπνῶν·	Who leadest the gladsome Muses
R φ σ ρ M ϊ M Καὶ σοφὲ μυστοδότα,	And thou, wise initiator into mysteries,
M ϊ E Z EM ρ σ M Λατοῦς γόνε, Δήλιε Παιάν,	Son of Latona, Delian Apollo,
M ϊ Z M φ σ σ Εὐμενεῖς πάρεστέ μοι.	Be at hand, propitious to me.

A SCALE TO EXPLAIN THE INTERPRETATION OF THE HYMN.

ᒣ R φ C or σ ρ M I Z E



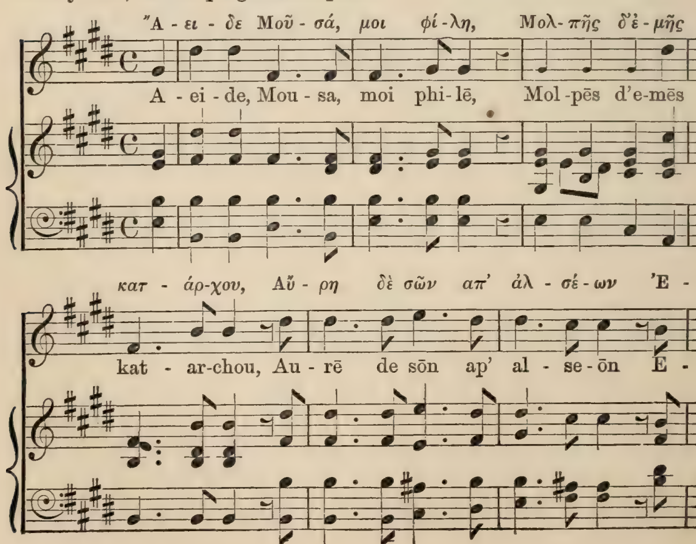
Since Dr. Burney's time other manuscripts of the hymns have been discovered. They supply the deficient φ in the first line, and vary the letter E over the fourth and sixth lines.

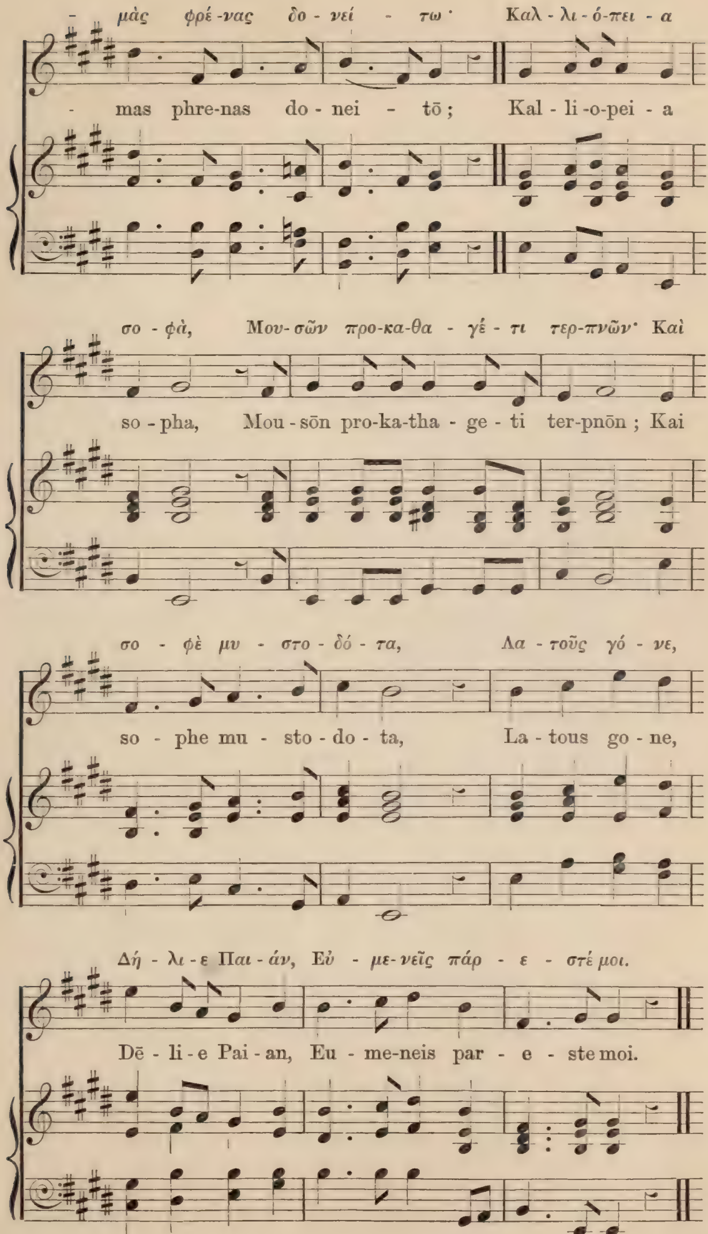
No. 1—HYMN TO CALLIOPE.

With an Accompaniment in the Hypo-Lydian mode, by G. A. MACFARREN.

THE SAME HYMN TO CALLIOPE.

The melody is again harmonized by my friend G. A. MACFARREN, in the key of E, which has G sharp as its major Third, and to which E, as key-note, all the progressions point.




- μὰς φρέ-νας δο - νεί - τω· Καλ - λι - ό-πει - α
- mas phre-nas do - nei - tō; Kal - li -o-pei - a
σο - φὰ, Μου-σῶν προ-κα-θα - γέ - τι τερ-πνῶν· Καὶ
so - pha, Mou - sōn pro-ka-tha - ge - ti ter-pnōn; Kai
σο - φὲ μυ - στο - δό - τα, Λα - τοῦς γό - νε,
so - phe mu - sto - do - ta, La - tous go - ne,
Δή - λι - ε Παι - άν, Εὐ - με-νεῖς πάρ - ε - στέ μοι.
Dē - li - e Pai - an, Eu - me-neis par - e - ste moi.

The preceding hymn proves two points. First, that it was not indispensable that there should be but a single note to a syllable in Greek music, for here are several cases of two notes to one vowel. Secondly, that a long note might be given to a short vowel as well as to a long one, for "spondee" is marked over a short vowel. These are strong arguments in favour of the system of bringing them into rhythm, for which I contend. In both cases, we find the same freedom exercised as in music of the present day. There is a Greek passage *On the Phrasing of a Composition,* by Dionysius of Halicarnassus, that would have been of advantage to Burette and to Burney, if they had known or remembered it. It is—"But rhythm and music diminish and augment the quantities of syllables, so as often to change them to their opposites. Time is *not to be regulated by syllables,* but syllables by time."[a]

That there may be mistakes in the music cannot be wondered at, after the repeated transcripts that have been required in so long an interval of time. No one of the manuscripts from which the above is derived is older than the fourteenth century, and they are mostly of the fifteenth.

The musical notation of Aristides Quintilianus, like that of Alypius, is altogether in capital letters. In the hymns, the capital R represents a broken Beta; the small Sigma (σ) represents the capital C, the older form of Sigma; and the small Rau (ρ) is a substitute for the Greek capital letter. The Greeks noted music by letters

[a] "*ἡ δὲ ῥυθμικὴ καὶ μουσικὴ μεταβάλλουσιν αὐτὰς μειοῦσαι καὶ αὔξουσαι, ὥστε πολλάκις εἰς τἀναντία μεταχωρεῖν· οὐ γὰρ ταῖς συλλαβαῖς ἀπευθύνουσι τούς χρόνους, αλλὰ τοῖς χρόνοις τὰς συλλαβάς.*"—(Περὶ συνθέσεως ὀνόματον, Reiske's edit., vol. v. p. 64.)

upright, inverted, jacent both on the back and on the face, turned right or left, and even by parts of letters. Such notation would be very subject to misconstruction by a copyist who did not understand the musical system; especially the broken letters, as he would most likely attempt to set them right. In some of the manuscripts there are letters that do not even belong to the scale. The Hymn to Apollo seems to begin correctly, but to be wrong in the after part. The authorship of the first two hymns, if not of all three, is attributed to Dionysius, in the Oxford manuscript, by the words *Dionysiou Hymnoi* at the commencement; but in other manuscripts the third hymn is attributed to Mesodmes, or Mesomedes. The rhythm of the second and third is of twelve syllables, or their equivalents in point of time, for each line of the poetry.

The Hymn to Apollo, saving the six lines of introduction, is set to music throughout; and it rambles about in a less tunable style than the other two. In the Hymn to Nemesis, there are only six lines with music, which is written over the first part of the hymn, except in one manuscript, and yet the poetry consists of twenty lines.

The Greek verses, which are not set to music, are so accessible to the curious, in Dr. Burney's *History of Music* and in other sources, that, not being directly within my subject, it seems unnecessary to reprint them. With the same motive of avoiding needless extension, the reprinting of the separate Greek text of the second and third hymns with the Greek music-letters over them, in addition to the modernized version, may be excused. The one

example of Greek musical notation over the Hymn to Calliope will probably be thought sufficient. There is, again, but little difference of notes between Dr. Burney's copy and the following, but much in the time allotted to them, as well as difference of key. The hymn is printed like the last, in the treble clef, and therefore an Octave higher than the real pitch, as if for a man reading music from the treble, or G, clef. In this case, however, it is left in the original scale of Alypius, C♯ minor, to show how high Greek hymns were, and the necessity for Claudius Ptolemy's system of transposition.

No. 2.—GREEK HYMN TO APOLLO.


Ἀκ - τῖ - να πο - λύ - στρο - φον ἀμ - πλέ - κων,
Ak - ti - na po - lu - stro - phon am - ple - kōn,
Αἴ - γλας πο - λυ - δερ - κέ - α πα - γὰν
Ai - glas po - lu - der - ke - a pa - gan
Πε - ρὶ γαῖ - αν ἅ - πα - σαν ἑ - λίσ - σων.
Pe - ri gai - an ha - pa - san he - lis - sōn.
Πο-τα-μοὶ δέ σέ - θεν πυ - ρὸς ἀμ - βρό - του
Po-ta-moi de se - then pu - ros am - bro - tou
Τίκ - του-σιν ἐ - πή - ρα - τον ἁ - μέ - ραν.
Tik - tou - sin e - pē - ra - ton ha - me - ran.
Σοὶ μὲν χο - ρὸς εὔ - δι - ος ἀ - στέ - ρων
Soi men cho - ros eu - di - os a - ste - rōn
Κατ' Ὄ - λυμ - πον ἄ - νακ - τα χο - ρεύ - ει,
Kat' O - lum - pon a - nak - ta cho - reu - ei,
Ἄ - νε - τον μέ - λος αἰ - ὲν ἀ - εί - δων,
A - ne - ton me - los ai - en a - ei - dōn,
Φοί - βη - ΐ - δι τερ - πό - με - νος λύ - ρᾳ,
Phoi - bē - i - di ter - po - me - nos lu - ra,

The Third Hymn is, in one respect, very remarkable; for, although noted, like the others, in the Hypo-Lydian mode, which, at the original pitch, is C sharp minor, it is rather in what we term its relative major, viz., in E. It is so, according to Aristotle's laws as to *Mese,* and, except for D natural, would be so by modern laws. By modern laws, D must be sharp to make a major Seventh in the key of E; and as D is natural in the Greek scale, because it is only a semitone, instead of a tone, above the ancient minor key-note, or Mese, therefore the modern key of E would lose one of its four sharps, and that one its major Seventh. If, then, D is to be natural, the modern key is A major, with three sharps, instead of E major, with four. The hymn is essentially in a major key, and is another of the many instances in

which the ear has guided to what is right against the musical laws of ancient times. There could not be a complete major key under Greek musical laws, even down to the close of the thirteenth century, after which Bryennius wrote, but every old minor scale had a major scale within it, by beginning on the third ascending note instead of upon the first, as in A minor to begin on C. So this is irregular music that would have been condemned by the critics of the age, but such as would, nevertheless, please the ear, and which has been sanctioned by the laws of later times.

And now as to the date of this Hymn to Nemesis, and therewith of how far back the practice of a major scale may be traced. The earliest evidence about the hymn, according to Burette, is that it "is more ancient than Synethius, a father of the Church, who flourished four hundred and twelve years after Christ; and who, in his ninety-fifth letter, quotes three verses from it as from a hymn that was sung in his time to the sound of the lyre." . . . "It has been attributed by some to a poet, named Mesodmes, who flourished under the emperor Justinian, but Burette thinks the name corrupted from Mesomedes; and Capitolinus, in his life of Antoninus Pius, mentions a lyric poet of that name, from whom that emperor withdrew a part of the pension granted to him by Adrian, for verses which he had written in praise of his favourite, Antinous. Eusebius, in his chronicle, speaks of Mesomedes as a poet originally of Crete, whom he calls a composer of Nomes for the Kithara, (*κιθαρωδικων νομων μουσικος ποιητης*) which agrees very well with the author of the hymn in question."[a] So

[a] Burney, i. 92.

says Dr. Burney, quoting Burette, but still the authorship is by no means certain, for these hymns are free compositions, in a very different style from Nomes.

And now, to judge upon strictly musical grounds, which seem not hitherto to have been taken into account. The scale in which the hymns are noted extends here to a Seventh above the key-note; yet they are upon the Lesser Perfect System, because they have the semitone, instead of a tone, above the key-note. No such extension of the Lesser Perfect System is mentioned by Claudius Ptolemy, writing in the first half of the second century of our era. If the compass had extended yet one note higher, so as to make an Octave above the key-note, it would not have been a Lesser System, but one of equal extent with the Greater; and Ptolemy's objection to it, as not being two Octaves in extent, and, therefore, not being "Perfect," would have been removed.[a] It resembles more the scale adopted by the Christian Church, which combined the Greater and Lesser Systems, but which they only employed in the Dorian and Hypo-Dorian modes. A second inference against any very considerable Greek antiquity is the mode in which the music of the hymns is written. We should hardly have expected Apollo or Nemesis to be addressed in the Lydian or Hypo-Lydian mode at any early period of Greek history, but these modes were very much used in comparatively later times. Boethius gives only the musical notation of the Lydian and Hypo-Lydian, and so does the author of a late Greek treatise of an anonymous writer, published by Bellermann. The hymns appear, then, to have

[a] Claud. Ptolemy, lib. ii. cap. 4.

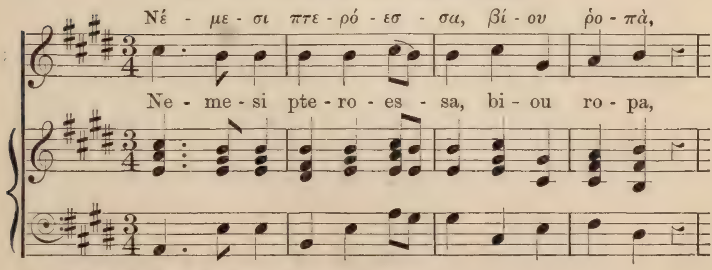
been written after the once-attributed characteristics of modes had been forgotten, and they were found to be mere differences of pitch.

These remarks are not offered as sure guides, but they lead to inferences that the date of the hymns is not earlier than from the second to the fourth century of our era. The poetry has been considered to "bear strong marks of having been written at a time when Greek poetry was still flourishing;" and it would appear, from the subjects, that Paganism must have been at least surviving, if not flourishing, also.

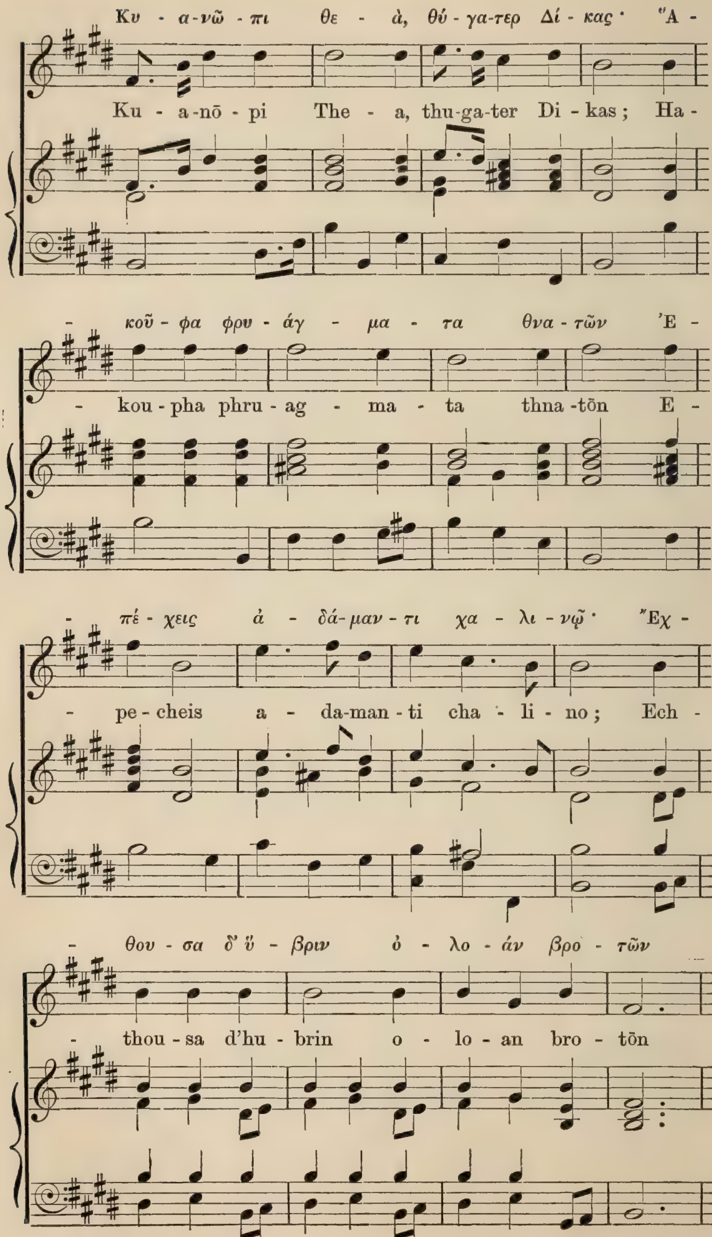
The translation of the music of the second hymn is printed at the old high pitch of the scales of Alypius, but Claudius Ptolemy's transposition to a Fourth lower is here adopted for this third, as for the first hymn, because they are sufficiently melodious to be sung as curiosities at this day. Both Euclid and Gaudentius say that the scale may be transposed to any semitone within an Octave.[a]

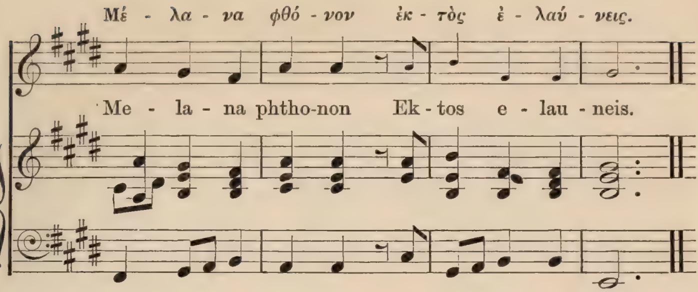
The harmony has been kindly contributed by my friend, G. A. Macfarren, who is the first person who publicly taught a system of harmony founded upon the laws of Nature, in this country, or in any other.

No. 3.—HYMN TO NEMESIS.



[a] Γίνονται δὲ αἱ μεταβολαὶ ἀπο τῆς πασῶν.
ἡμιτονίας ἀρξάμεναι, μέχρι τοῦ διὰ


Κυ - α-νῶ - πι θε - ὰ, θύ - γα-τερ Δί - κας· Ἄ -
Ku - a-nō - pi The - a, thu-ga-ter Di - kas; Ha -
- κοῦ - φα φρυ - άγ - μα - τα θνα - τῶν Ἐ -
- kou - pha phru - ag - ma - ta thna -tōn E -
- πέ - χεις ἀ - δά-μαν - τι χα - λι - νῷ· Ἔχ -
- pe - cheis a - da-man - ti cha - li - no; Ech -
- θου - σα δ' ὕ - βριν ὀ - λο - άν βρο - τῶν
- thou - sa d'hu - brin o - lo - an bro - tōn



The music to the second part of the Hymn to Nemesis has hitherto been found only in one manuscript of the fifteenth century, which is included in the Royal Library at Naples.[a] Like all the other manuscripts, it is in an imperfect state as to the music for some few words, but this is not to be wondered at, considering that the date of the author cannot be later than the fourth century, and is, perhaps, of the second or third. Several intermediate transcriptions had, in all probability, been made. Again, there are some notes so evidently wrong that, in three cases, I have changed one, giving a memorandum of the

[a] The reference given by Bellermann is No. 262, iii., c. 4, fol. 83. This MS. includes the treatises on music of Bryennius, Bacchius, and Aristides Quintilianus. Another manuscript, also of the fifteenth century, in the same collection, includes the hymns. It is 259, iii., c. i., fol., 218 verso. In this are Claudius Ptolemy with Porphyry's Commentary, Plutarch on Music, Aristides Quintilianus, and Bacchius. The other manuscripts quoted by Bellermann are No. 3, in the Royal Bavarian Library at Munich, codex 215, fifteenth or sixteenth century, containing Porphyry, Plotinus, Ptolemy, an anonymous Peri Mousikēs, Aristides Quintilianus, and Bacchius—the hymns at fol. 457. No. 4, in Paris, No. 2458, written by Petrus in 1544. No. 5, in the University Library at Leyden, is No. 47 of Scaliger's collection, and of sixteenth century. No. 6 is in the Library of St. Mark, Venice, codex 318, of fourteenth or fifteenth century — 241 folios, including the arithmetic of Nicomachus and Domnius, Ptolemy, Porphyry, Manuel Bryennius, Nicomachus, Bacchius, &c. This manuscript is deficient as to music for the hymns.

change at the foot of the page. Having learnt a little of the Greek system, and especially its strong resemblance to our own, I cannot conceive them to have been so written by the author. There are other cases of a doubtful nature, but the intention of the composer cannot so easily be discerned. These must await the finding of another manuscript. In the meantime, the continuation of the hymn is not equal to the first part.

THE CONTINUATION OF THE HYMN TO NEMESIS.

* This B would be A, according to the manuscript, but here the manuscript is undoubtedly wrong.

† G in the manuscript, which cannot be right.

‡ This should be B, according to the manuscript. After the next note, D, the remainder of the music is deficient.

It seems now so hopeless to anticipate a discovery of any more genuine remains of ancient Greek music, that it may be sufficient to point out the scales at p. 27 of Aristides Quintilianus, in Meibom's *Antiquæ Musicæ Auctores,* as the more probable of the two clues in such a case. In the lower part of that page the enquirer will find, in Greek notation by letters, a complete scale, including every semitone exactly as in our modern Chromatic scale, from Gamma, or the G on the lowest line of the base clef, up to the "b," which is three Octaves and a major Third above it. The upper line is for the voice and the under letters are for the lyre. If this clue be copied out over the notes which the letters represent, the process will be found far less tedious than by turning from one mode to another, in the pages of Alypius in the same collection; but his work can also be referred to in case of need. There is no great difference between the two systems, but it is more probable that the clue given by Aristides should serve, than the seemingly earlier one by Alypius, of whose date nothing certain is known, but which has been variously conjectured as of the second, and as of the fourth century of our era.

The difficulties of Greek musical notation have been often exaggerated. Burette is one who indulges in this hyperbole, and Burney quotes the passage :—

"It is astonishing," says M. Burette, "that the ancient Greeks, with all their genius, and in the course of so many ages as music was cultivated by them, never invented a shorter and more commodious way of expressing sounds in writing than by sixteen hundred and twenty notes."—(Burney, i. 19.)

Burney argues gravely against this assertion; but neither he, Burette, nor any later historian with whose works I am acquainted, seems to have observed the table of Aristides Quintilianus, which was under their eyes, at p. 27 of his treatise. Besides this, there are other copies of those scales which were sent to Meibom by Selden, and by Gerard Langbaine, at pages 243 and 244 of Meibom's notes. Learned men of the last century did not turn to original sources overmuch.

The entire notation of all the modes is comprehended by Aristides in thirty-eight double letters (*grammata*). Quarter-tones are not included, but as there was but one such sound added in each tetrachord, and so, two in each Octave, eight more double letters would have sufficed. In any case the total must fall far short of sixteen hundred and twenty.

There is a Greek notation by another set of signs, which was employed for rhapsodizing. This system is still employed in the services of the Greek Church in some parts of the world. A similar kind of notation by neumes, or signs for raising and lowering the voice, (*pneumata*,) was once in use in the Western Church. The conversion of the latter to the purposes of music seems to date only from the middle ages, and will form the subject of a later chapter.

CHAPTER IX.

Basis of the science.—Its fundamental laws.—Earliest uses of music.—Mathematical divisions of strings not alone sufficient.—Minor tones introduced by Didymus, and followed by Claudius Ptolemy.—Neither the Greek scale nor the modern is properly in one key.—Hence the question whether Elevenths were concords.—How to test intervals.—The true proportions for scales.—Rules for adding and deducting intervals.—Scales of Didymus and of Ptolemy.—Defects of the modern scale.—The law of Nature the only true guide.—Objections to the Fourth and minor Seventh of the present scale.—Causes of Concord and Discord.—Pythagorean ideas realized by modern science.—Sounds too high and too low for our hearing.

The discussion of ancient and modern science must, in a measure, go hand in hand; for, as our present scale is Greek, so whatever applies to ancient times is equally applicable to the present. No science has more fixed and clearly established fundamental laws than music. The wind will teach them as it plays upon the strings of an Æolian harp; for, although tuned to one pitch, it will cause them to emit sounds of every variety. The same law exists in the natural sounds of a trumpet, horn, or open tube of any kind, and all the notes will follow in the same succession. By blowing into the tube so slowly as just to make the sound continuous, the lowest, or fundamental note, produced by the entire length of the pipe is first heard; then, by gradually increasing the rapidity of the breath, an ascending series of notes will follow; every one of which may be predicted as

they rise gradually, higher and higher, up to the extreme pitch that can be obtained from the breath of the mouth. The same rising succession of notes is heard in the harmonic sounds that follow upon one of the long strings of a pianoforte, after the fundamental note, produced by the whole length of string, has been struck, and when the string gradually subdivides itself into smaller and smaller nodes before finally coming to rest. They then follow so rapidly as to seem to run one into the other. From these laws, we may deduce both a perfect Diatonic, and a perfect Chromatic scale from any given note. The proportions of musical intervals may be measured either by the divisions of a string, or by the gradual cutting down of a pipe. Results in harmony may be foretold with certainty as either good or bad, by calculating the proportions of the intervals together with the roots of the sounds, and without any appeal to the ear. Again, the ears may be stopped, and the eye will tell, from the motions of sand scattered upon the sounding board of a pianoforte, or any other vibrating surface, whether the chord that has been struck upon the instrument has been a concord or a discord. In the former case, the movements of the sand will be symmetrical and regular; and, in the latter, they will show that discord reigns by their disturbed state, and by their seeming to battle together.[a] The Octave is the first ascending sound, after the primary one, in the harmonic scale of nature, and all subsequent sounds are but subdivisions of it at higher pitches. The Octave system, with its

[a] The following optical representation of the musical intervals of the Fourth, Fifth, and Octave, as shown by sand upon a vibrating surface, is

included and harmonic-following Fifth and Fourth, and major and minor Thirds, is the foundation of all music. Sound, as is well known, does not exist in the atmosphere, but is an affection of the brain produced by succeeding elastic waves of air that strike upon the drum of the ear, and which, for that reason only, are called "sound-waves."

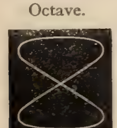
From all this, and from much more that might be said, there can be no more evident fact than that it was the design of the Creator that music should be the companion and the solace of man; and from this we may deduce that, in the mouth of man, there can be no more fitting medium for the praise of his Maker.

The ancient heathen attributed a divine origin to their music, and, accordingly, the earliest uses to which we find it to have been applied by them are those of religious worship. At a later period, music was also cultivated for educational purposes, especially among the Greeks, and chiefly with the view of elevating the mind above its too frequently grovelling tendencies. "The first and noblest application of music," says Plutarch, "is in offering the tribute of praise to the immortals: the next is the purifying, regulating, and harmonizing the soul."

Speaking of times past, Plato says: "Our music

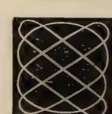
copied from the *Quarterly Journal of Science* for January, 1870. (No. 25.) The lower note of each interval is middle C, or the C below the lines in the treble:—

Octave.



Fifth.

Fourth.



was then divided according to certain species and figures. Prayers to the gods were one kind of song, to which they gave the name of hymns. Opposed to this was another species which might be called *Threni*" (Funeral Dirges), "another, *Pæans*" (Choral Songs to Apollo or Artemis), "and another, The Birth of Dionysus" (the Greek Bacchus), "which I hold to be the dithyrambic verse. There were also *Nomes*" (or simple and severe chants upon a few high notes), "accompanied by the Kithara, which were equally distinct. These and some others being prescribed, it was not allowable to use one kind of chant for another. But, in process of time, the poets introduced unlearned license; they, being poetic by nature but unskilled in the rules of the science, trampled down its laws. Over-attentive to please, they mixed threni with the hymns, and pæans with dithyrambs, imitated music intended for the flute upon the Kithara, and confounded each kind with every other."—(*Laws*, lib. iii.) Add to this Plutarch's account. He says: "In the yet more early times, the music of the theatre was unknown to the Greeks; the whole art being then made subservient to the honour of the gods, and to purposes of education. Theatres themselves were then unknown; and their only music consisted of those sacred strains which were employed in the temples as a means of paying adoration to the Supreme Being," (*te tou theiou,*) "and of celebrating the praises of the great and good of our species. It is probable that the modern word 'Theatre,' and the very ancient one '*theōrein*' (to look at), have their derivation from *Theos*, the Deity. In the present day, so great is our degeneracy, that

we have absolutely lost both the knowledge and the notion of that system by which youth were formerly trained up to honour and virtue. The only music now studied and listened to is that of the theatre."—(*De Musica*, cap. 27.)

Notwithstanding the divine origin attributed to music, it is very doubtful whether any of the civilized nations of antiquity knew the laws of Nature as to the prescribed succession of musical sounds, or, perhaps, much beyond the general observation, such as that of Aristotle,[a] that high notes are of more rapid vibration than low ones. So far as we are acquainted with ancient systems of music, they seem to have been founded upon the divisions of a string upon some instrument of the monochord kind, with a movable bridge (*hupagōgeus*) under it, for the purpose of measuring; or else to divide by pressing the string against a finger-board. Since, then, the science of music was thus learnt from a string, it must surely offer the most simple and intelligible means of explaining it. It will give the least amount of trouble to the reader; and, although there must be figures in all cases, yet, if explained by a string, nothing more than the elementary rules of arithmetic can be required.

The Greek system is defective in one essential point—that, although the divisions of a string will show the ratios that its parts or intervals bear to the whole length, they will not point out the positions in which those intervals must be placed in a musical scale, so as to make consonances of them by keeping them within one

[a] Aristot. *De Audib.*, p. 801 and p. 803, edit. Bekker.

key, or from one root. So, a scale may look well proportioned upon paper and yet be practically bad. The same length of a string may be divided off in one part, so as to be concordant with the rest; and, in another part, to be discordant.

The defects of this origin are shown in many of the Greek scales, and, among others, in our own, it being wholly Greek.

The Octave, the Fifth, the Fourth, and the major tone, (*i.e.*, sounding eight-ninths of a string compared to the whole length,) were included in the Pythagorean system of music; and the seemingly slight change which created true consonant major and minor Thirds, and the minor tone, (of nine-tenths of a string compared to the whole,) were improvements introduced by Didymus about the commencement of the Christian era, and followed by Claudius Ptolemy, about the year 130 or 140. Still, the Greek Diatonic scale remained a compound of sounds derived from different roots, and was, and is, therefore, strictly speaking, in different keys.

For instance, in our adopted scale of C major, one-half of the Diatonic Octave, or the notes on the long keys of the pianoforte, is in the scale of C, and the other half is derived from the scale of F. This is consequent upon its having been composed out of two Greek conjoined tetrachords, B, C, D, E, and E, F, G, A, which, when taken as parts of a major scale, and not of a minor, as of old, have their roots or key-notes the one in C and the other in F. If a minor scale were to be tested in the same way, it would show greater variety of roots, therefore greater deviation from the right path.

A comparison with the scale of Nature will presently prove this; but, in the mean time, in order that the purport of these remarks may be understood, suppose that, in the key of C major, we sound C in the base, and with it C and F in the treble, the last two being at the interval of a Fourth. The treble F makes a discord with the base C. But if we again sound the upper C with the G immediately below it, instead of the F above, and retain C as the base, it is a concord. And yet from G to C, and from C to F, are both Fourths taken from the key-note, the one above and the other below it, in our key of C. The difference is, that from C to F is an artificial interval, disavowed by Nature in her scale of C, but from G to C is Nature's interval. The former is from the root of F, and requires F for its base. Then it will be concordant. These cases will be further exemplified in the sequel.

As my present subject is the Science of Music, I speak freely of the defects of our adopted scale. Its deficiencies may at least be made known, however improbable any change of system may be. Let us face the difficulties, and see what a dwarfed scale for melody we have to work upon, through having copied from the Greeks.

The intervals from G to C and from C to F, were two of the puzzles to writers upon Harmony, not only for several ages past, but even far into the present century. They had no rule by which they could duly account for Fourths being both discords and concords in what was considered to be one key, so they divided themselves into opposite camps; the one contending that Fourths, and what have been

called "Elevenths," or combined Octaves and Fourths, were concords, and the other as stoutly maintaining that they were discords. Neither of the two parties thought of appealing to the Harmonic scale for the solution of the difficulty. Harmonics were, until lately, more looked upon as a trouble to pianoforte makers that ought to be got rid of, than as containing the essence of music, and as being therefore a necessary study for a musician. There is indeed little that can be more instructive than a comparison of our scale, calculated by Greek mathematicians, with that most ancient of all scales—the scale of Nature. Every musical interval within the Octave may be so misplaced as to leave the key and become a discord, and it is from the scale of Nature only that a fitting position for each has to be determined. Mathematical scales are insufficient without it, and yet this material deficiency in them, and especially in our own scale, has been but little thought of. A choice of good intervals may suffice for varied harmony, but to be consonant in one key, they *must* be derived from the same root.

The Greek scale which preceded the time of Didymus, although usually coupled with the name of Pythagoras, might equally be called the scale of ancient Asia, and of ancient Egypt. It has already been shown that the Greek one-octave scale began a Fourth below the key-note, thus taking the interval of the Fourth downward in its consonant form to the key-note or *Mese*, and that it ended a Fifth above the key-note. Also that the Fifth above the key-note was compounded of a major tone, called diazeuctic, or disjunctive, and of another Fourth. So the

skeleton of the Octave was thus complete, and there remained but to fill up the two Fourths by smaller intervals. So far the Greek scale and the scale of Nature agree, and from that point they part company. These Fourths were originally subdivided, each into two major tones and a remnant. The choice of major tones was directed by one of them being the exact interval between a Fourth and a Fifth. When two of them were included in a Fourth, the remnant became one of that kind of semitone which was in the ratio of 243 to 256, to which the name of a *diesis* was given by the earliest Pythagoreans, such as Philolaos, but which later Pythagoreans named *limmas*, meaning "remnants" of the interval of the Fourth, after the two tones were taken out of it. Aristoxenians and Greek practical musicians called these remnants semitones, but such semitones are different from the semitone of later Greek, and of modern music.

When the Greek scale was extended to two Octaves, by adding on a Fifth at the lower extreme of the original Octave scale, and a Fourth at its upper end, the two-octave scale began and finished at the key-note, like our own, and equally agreed with Nature's law as to the *skeleton* of the Octave. Therefore, for the comparison of ancient with modern music, which is here proposed, we will take one Octave in this latter form. Suppose the key to be Hypo-Dorian, or A minor, then from A to B will be the disjunctive tone, and there will remain the two conjoined Fourths, B, C, D, E, and E, F, G, A, just as on the long keys of a pianoforte.

The way to test such intervals as the Octave, the Fifth, the Fourth, the major Third, and the

minor Third, upon a string, is to stop[a] successively the half, the third part, the fourth, fifth, and sixth parts, and to sound the remainders of the string, comparing each of these intervals with the sound of the whole length. We have no equivalent in modern music to the note produced by stopping the seventh part of a string, which is the Harmonic Seventh, but it is a natural note upon the horn. It was employed in the last century with untempered instruments, such as fiddles and basses, in small bands, as well as for ages before, when horns and trumpets had no keys or slides. It affords additional passages in melody without change of key. It is called the Harmonic Seventh in reference to its key-note, so, in C, would be called Harmonic B flat, and we might employ it where we cannot use our B flat, because the latter does effect a change of key. Swiss singers, says Spohr, in his Autobiography, employ the Harmonic Seventh in their music, as well as the Harmonic Fourth, which is the interval produced by stopping the eleventh part of a string. They are quite right to do so, because they enlarge their sphere of melody, and have Nature on their side in both cases. The Harmonic B flat divides the upper Fourth, from G to C in the key of C, into two all-but-equal parts, and these might be called Thirds, but they are of diminishing compass, and next to the minor Thirds that we employ. Nature's Octave is divided into eight tones, beginning with the eighth part

[a] Whenever "stopping" any part of a string is here mentioned, the meaning is absolute stopping or *shortening the length* by so much, and sounding the whole remainder. The string must not be touched lightly at a point, for that would make it subdivide itself by nodes, and produce quite a different effect.

of a string up to the sixteenth part; but we, following the Greeks, Chaldæans, and Egyptians, with their seven planets and seven notes, have still but seven. Nature divides the interval, from G to C into the same number of parts as that from C to G.

As the seventh part of a string gives the Harmonic B flat, so the eighth part stopped gives the key-note, C, above it. I have already said that the stoppings of the ninth and of the tenth parts of a string raise its pitch by the intervals of our major and of our minor tone. From those, the moderns pass on to the sixteenth part, and by stopping it, they raise the note by what is now termed indifferently a major semitone, or a Diatonic semitone. When we pass down from C to B, or from F to E, it is by the semitone in question. Its name is from the Latin, and that of hemitone from the Greek, but they are equally improper; because, instead of being a semitone, the interval of a sixteenth part of a string is really the smallest of the eight tones of Nature. It is too wide to be the half of even our major tone. Its name should have been changed when Didymus and Ptolemy enlarged its proportions. The Pythagorean *limma*, or Aristoxenian semitone, was as 243 to 256, and Didymus changed it to 240 to 256, which is as 15 to 16.

A true tonal scale is from the eighth to the sixteenth part of a string, whatever the length of that string may be. Length only changes the fundamental note. The two intervals to which we give the name of tone are the largest of the eight of Nature's. Those eight decrease progressively in the ascending Octave; and we employ but three of them, viz., the

largest two, and the least. We name the first two "Tones," and this least we misname "a major or Diatonic semitone."

There is another, and a truer semitone, in modern music. It is produced by stopping the twenty-fifth part of a string, and therefore is *much* less than the Diatonic semitone. It is the true interval between G and G sharp in Nature's scale, when C is the fundamental sound, or key-note. This semitone, like the other, has two names. It is called "minor," and "Chromatic," and it is employed when the name of the note remains unchanged, as from F to F sharp, or from G to G sharp.

All the before-named intervals were used by the Greeks in some one or other of their scales. Even the Harmonic Fourth and the Harmonic Seventh were thus included.

Our major and minor semitones were coupled together in the Chromatic scale of Didymus, and the two combined are equal to one minor tone. Hence, when he added the usual interval of a minor Third between the highest two strings of the Fourth or tetrachord, he made the best possible arrangement for a Greek Chromatic scale. With two such tetrachords, and the diazeuctic major tone, he completed the Octave.

His Enharmonic scale was equally good, for he divided his major semitone, $\frac{15}{16}$, into its two best quarter-tones, $\frac{30}{31}$ and $\frac{31}{32}$. Then a major Third, $\frac{4}{5}$, completed that tetrachord.

But, before referring further to figures, there are three simple rules that every incipient musician should know. It is not, however, to be assumed

that all do know them; for although it must be supposed that there are books on music which contain these rules, yet it has not been my fortune to have met with any one of them. Musicians appear too generally to have thrown such information aside, and mathematicians, when writing upon music, assume that their readers know every kind of rule beforehand.

It is indispensable for a real musician, that he shall be able to tell with certainty what will be the effect of any combination of intervals, and he may often wish to ascertain it for himself when he cannot have the opportunity of testing them practically. It is well, therefore, to know how he can judge of them on paper, with even greater certainty than by ear, however good that ear may be. Indeed, it is by far the more convenient way of testing unfamiliar intervals.

The three rules are—How to add intervals; How to deduct one from another; and How to compare one with another. The answer to all may be comprehended in a line. To add, multiply; To deduct, cross-multiply; To compare, bring them to a common denominator. Still, these directions will not be, in all cases, sufficient; and, in order to be understood by all, I hope to be excused for further explaining and exemplifying them.

To *add* one interval to another, *multiply* the numerator by the numerator, and the denominator by the denominator. If we say three-eighths, three is the numerator, and we denominate eighths. Then reduce the multiplied totals to their smallest figures, by finding out what is their "Greatest Common Measure."

To do this, we must follow the ordinary rule of arithmetic, which is thus expressed :—"Divide the greater by the less, and the preceding divisor by the remainder, and so on continually until there is no remainder. The *last divisor* will be the Greatest Common Measure."

This will perhaps be more quickly understood by an example. The ancient Pythagorean tetrachord, or Fourth, consisted of two major tones and a *limma*, or remnant; in other words, of the three intervals, $\frac{8}{9}$, $\frac{8}{9}$, and $\frac{243}{256}$.[a]

Then for the two major tones and *limma* = $\frac{8}{9} \times \frac{8}{9} \times \frac{243}{256} = \frac{15552}{20736} = \frac{3}{4}$ to be explained thus :—

For the numerator, 8 times 8 are 64, and 64 times 243 are 15552. For the denominator, 9 times 9 are 81, and 81 times 256 are 20736. Divide the greater by the less, 20736 by 15552; it leaves 5184. Then 15552 by 5184, and it leaves no remainder. Therefore, 5184 is the last divisor, and the Greatest Common Measure. Divide the two original sums by 5184; it shows $\frac{15552}{20736}$ to be equal to $\frac{3}{4}$.

For the second rule—To subtract one interval from another, by cross-multiplication, the readiest way is to invert the figures of one of the two ratios, and to place them *under* the others. Then to multiply the upper by the under. This position of the figures is the more convenient for a sum. To prove the rule in the simplest way, we know that 4 to 2 is the same ratio as 2 to 1. Cross-multiply, and it will show them to be equal. Again, we

[a] In stating these sums it will save space to adopt the usual signs, viz., $\times$ for multiplication, $+$ for addition, $\div$ for division, $=$ for equals, $-$ for deduction, and $::$ for proportion. As 4 is to 8, so is 9 to 18, stated thus :—$4 : 8 :: 9 : 18$.

know that a Fifth and a Fourth together make an Octave, as from C up to G, and from G to Octave "c." Therefore, if we deduct a Fifth from an Octave, the remainder ought to be a Fourth. The ratio of the Octave is as 1 to 2 in length, or as 2 to 1 in vibrations. The interval is the same either way, so the case may be stated either way. Here, adopting the former, the Fifth is as 2 to 3, and the Fourth as 3 to 4.

Therefore, taking the Octave as . . . . . . 1 : 2
Multiply by the *inverted* figures of the Fifth, 3 : 2
The remainder shows the Fourth, viz. . . . 3 : 4

For the third rule—How to compare intervals. The most useful example will be to take our present scale, and to compare every interval with its key-note in C. To D is a major tone, $\frac{9}{8}$, or as 9 vibrations to 8 of the key-note. To E, a major Third, $\frac{5}{4}$, or 5 vibrations to 4 of the key-note. To F a Fourth, in figures $\frac{4}{3}$. To G a Fifth, $\frac{3}{2}$. To A a Sixth, in figures $\frac{5}{3}$. To B a major Seventh, $\frac{15}{8}$. Lastly, the Octave is as 2 to 1 of the key-note. So the scale stands thus: 1, $\frac{9}{8}$, $\frac{5}{4}$, $\frac{4}{3}$, $\frac{3}{2}$, $\frac{5}{3}$, $\frac{15}{8}$, $\frac{16}{8}$. As the
C, D, E, F, G, A, B, C.
Octave here includes odd numbers, as four to *three*, and five to *three*, which are two of the imperfections of our scale, we cannot have a lower common denominator than 24, where it ought to be 8. So we must multiply every ratio by such figures as will bring its under-figures to 24. For instance, $\frac{9}{8}$ is equal to $\frac{27}{24}$, multiplying by 3. Next, we must multiply $\frac{5}{4}$ by 6, and so on—24, $\frac{27}{24}$, $\frac{30}{24}$, $\frac{32}{24}$, $\frac{36}{24}$, $\frac{40}{24}$, $\frac{45}{24}$, $\frac{48}{24}$. Then dropping the lower figures, we compare the proportions of our Octave scale as 24, 27, 30, 32, 36, 40, 45, 48.

This rule, or multiplying the ratios by 24, is necessary for understanding Dr. Wallis's edition of Claudius Ptolemy, and many more books.

When the principal intervals are stated in figures, according to their proportionate *vibrations*, the Octave is written $\frac{2}{1}$, or 2 to 1. The Fifth as $\frac{3}{2}$, or 3 to 2. The Fourth as $\frac{4}{3}$. The major Third as $\frac{5}{4}$, and the minor Third as $\frac{6}{5}$. The major, or Diatonic semitone, as $\frac{16}{15}$.

And now, having given the three necessary rules, I will in future state only the results, and leave them to be tested by the curious.

One of the Greek scales in which the Harmonic Seventh, or seventh part of a string, was employed, is exceedingly worthy of note, and quite an exceptional scale in Greek music. It is the Even Diatonic (*Diatonon homalon*) of Claudius Ptolemy, given in the 16th chapter of his first book. The remarkable part is, that he follows out the natural division of the scale in all the intervals that are included in the Fifth, from the key-note upwards. Therefore he has so far a *true* major scale, with its major Third, instead of the perpetually recurring minor Third—that minor Third being always consequent upon the disjunctive major tone immediately above the key-note, and to the semitone of the tetrachord being next above it, as A to B, and B to C. They caused Greek scales to be always minor. Jean Jacques Rousseau's remark, that the minor scale is not given by Nature, is a very just one.[a] After the major Third, which is in the place of the old minor, Ptolemy

[a] "La mode mineur n'est pas donné par la Nature ; il ne se trouve que par analogie et renversement. Cela est vrai dans le systême de M. Tartini, ainsi que dans celui de M. Rameau." — (*Dictionnaire de Musique*, under "Mode.")

employs the Harmonic Fourth, or the eleventh part of a string, being a nearly equal division between E and G. So, in the scale of C, Ptolemy has C, D, E, Harmonic F (instead of our F), and G. Next, as to the tetrachord, or Fourth, below the key-note, he first divided it into its two legitimate parts by Harmonic B flat. So far he had proceeded thoroughly according to natural laws, but as that one division of the Fourth gave him only three notes—G, Harmonic B flat, and C—and four were required for a Greek tetrachord, he altered that excellent arrangement, and repeated the intervals that he had just employed in the Fourth above the key-note, viz., for the D, E, Harmonic F, and G.

Before that change, he had adopted Nature's scale so far as taking successively the sixth, seventh, eighth, ninth, tenth, eleventh, and twelfth parts of a string. Yet he was not led to it by any insight into Nature's laws, but by one of the Pythagorean doctrines which neither Pythagoras nor his school had ever carried out. The doctrine was to employ only super-particular ratios, such as 10 to 9, 9 to 8, 8 to 7, 7 to 6, 6 to 5, 5 to 4, 4 to 3, and 3 to 2. As Ptolemy here employed them in gradually decreasing intervals, he fell into the law of Nature.

When the Pythagoreans gave the name of *limma* to the proportions of 243 to 256, which are less than the half of a major tone, they called the remaining greater part an *apotome*, or segment. It had the awkward proportions of 2048 to 2187. The comparative sizes of the two will be made clearer if we multiply the figures of the *limma* by 8, thus making it 1944 to 2048. The difference between these two was called a Pythagorean comma (komma), viz.,

524,288 to 531,441. Therefore, if a Pythagorean comma be added to two *limmas*, it makes one major tone. But there is another point to be noticed about this comma. If twelve *perfect* Fifths be taken from any note—say from C upwards—they will end upon B sharp, and it will be a Pythagorean comma *sharper* than the seven-octave C. The reason of this reversal of order is, that we make Fifths where Nature has not designed them, because the notes have to serve other purposes. Octaves are the only continuously perfect intervals.

A few other intervals with peculiar names will sometimes be met with; and, being bound to explain them, it is better at once to clear the board. A minor semitone deducted from a major semitone, leaves what is *now* termed an Enharmonic *diesis*, 125 to 128. This *diesis* is less than one of the Enharmonic-quarter tones of Didymus, $\frac{31}{32} = \frac{124}{128}$. The modern Enharmonic *diesis* is a nominal difference between C♯ and D♭.[a] The interval between our Diatonic, or major semitone, and a major tone is $\frac{128}{135}$.

A Greek Enharmonic *diesis*, or quarter-tone, is sometimes called a *Tetartēmorion*, meaning "quarter-piece" of a tone, and a Chromatic *diesis*, or third part of a tone, is called a *Tritēmorion.* These two intervals have not infrequently been mistaken by lexicographers for the much larger ones of a Fourth, which is two tones and a half, and of a Third, which is two tones.

A *Schisma* is an interval to be read of in mathe-

[a] This modern law seems to have been made to maintain the interval of a Diatonic semitone, whenever one of the two notes changes its name.

matical music, but one not often brought into practice. It is the approximate half of a Pythagorean comma. A *Diachisma* is a similar division of the before named *limma*. As the interval of a *Diachisma* approaches to a quarter-tone, it may have been practically employed in the ancient Enharmonic scale.

Lastly, the comma of Didymus is sometimes referred to as a syntonic comma. This is an important interval in modern as well as in ancient music. It is far more so than the comma of Pythagoras. The comma of Didymus is the interval between a major and a minor tone, or between the eightieth and the eighty-first parts of a string.

So delicately organised is the human ear, that it was but this eighty-first part that worked the great revolution between the ancient scale of Pythagoras and the very present scale. First, Didymus, and, after him, Claudius Ptolemy, deducted this comma from one of the two major tones that formed the ancient Ditone, or over-sized major Third, and so changed it into our consonant major Third. Moreover, the comma thus taken away from the tone was added to the *limma*, and brought that interval into its present proportions as a major semitone. By these changes the Greek Diatonic scale attained its present improved proportions. So, the difference between a major and a minor tone, as well as that between a *limma* and a major semitone, is a syntonic comma, or comma of Didymus, or the eighty-first part of a string.

To prove the effect of this apparently small, but really very important, change, we have but to add together the two major tones of which the ancient

Ditone, or Pythagorean Third, consisted, by multiplying the numbers $\frac{8}{9} \times \frac{8}{9} = \frac{64}{81}$. If it had been a true major Third, the ratio would have been $\frac{64}{80}$, which is the same as $\frac{4}{5}$, as will be found by dividing the two numbers by 16. Although the old Ditone did pass for a Third in melody, it would not bear the test in harmony. Every ear found it to be a harsh discord. The ear is so much more delicately organised than the eye, that even a hundred and sixtieth part of difference in vibrations, in one second of time, has a rough and unsatisfactory effect, which every ear can distinguish; whereas the quickest eye cannot distinguish, or count, more than twenty-four vibrations in the same brief period. The delicacy of the one organ is quite as eight to one of the other.

The improved major Third of Didymus and of Ptolemy consisted, like our own, of two tones, the one major and the other minor: $\frac{8}{9} \times \frac{9}{10} = \frac{72}{90} = \frac{4}{5}$. Then the *limma* being changed into a major semitone, $\frac{15}{16}$, made a true Fourth: $\frac{4}{5} \times \frac{15}{16} = \frac{60}{80} = \frac{3}{4}$.

And now as to the discordance of the minor Pythagorean Third, which must also be proved; for there is nothing like proof to fix anything as a fact upon the memory. It consists of a *limma* and a major tone: $\frac{243}{256} \times \frac{8}{9} = \frac{1944}{2304} = \frac{27}{32}$. Twenty-seven to thirty-two are indifferent proportions that carry discord with them. They are neither multiple, as 2, 4, 8, 16, 32, nor super-particular, *i.e.*, one number is not the unit, or one "particle" above the other. They want the comma to make them super-particular and consonant. The ratio is identical with our imperfect minor Third of to-day, as between D and F, when the scale has been tuned for the key of C; because it has then a minor, instead of a major

tone in it: $\frac{15}{16} \times \frac{9}{10} = \frac{135}{160} = \frac{27}{32}$. This defect was inherited from Claudius Ptolemy's scale. The true minor Third consists of a *major* tone and a *major* semitone: $\frac{15}{16} \times \frac{8}{9} = \frac{120}{144} = \frac{5}{6}$.

One of the musical laws of Pythagoras was, that, to be concordant, all ratios must be either multiple (*pollaplasioi*), like the Octave, 2, 4, 8, or like the Twelfth, 3, 9, 27, 81, or else they must be superparticular (*epimorioi*), as 3 to 2, 4 to 3, or 5 to 4. This doctrine is referred to, among others, by Aristotle, in his 41st Problem of Section 19. We have every reason to suppose it to have been derived among other laws, from Egypt, because, although it was held as a maxim by the school of Pythagoras, it was very imperfectly acted upon either by him, or by his disciples, for a full 500 years after his death. Therefore, his followers could not have regarded it as a really essential principle in music, and as a law of Nature in the division of a string, or of a column of air enclosed in a pipe. If otherwise, they acted too inconsistently in having admitted only the Octave, the Fifth, and the Fourth, as simple consonances. They should have included intervals in the ratio of 5 to 4, and 6 to 5, which would have added the major and minor Thirds to their scales in a consonant form. When Claudius Ptolemy followed out their doctrine, and so brought true major and minor Thirds into his scales, he twitted the followers of Pythagoras with their inconsistency in that respect. — (Ptolemy, lib. i. cap. 6.)

Neither the Octave, nor any interval within the Octave, can be divided into equal parts. The most consonant and the nearest to equal division of the

Octave is into a Fifth and a Fourth, and the ratios of both are super-particular, $\frac{2}{3}$ and $\frac{3}{4} = \frac{6}{12} = \frac{1}{2}$. The Fifth must, in like manner, be divided into major and minor Thirds, $\frac{4}{5} \times \frac{5}{6} = \frac{20}{30} = \frac{2}{3}$. The best division of the Fourth would be by the Harmonic Seventh, making from G to C $\frac{6}{7} \times \frac{7}{8} = \frac{42}{56} = \frac{3}{4}$. The major Third would be into major and minor tones, $\frac{8}{9} \times \frac{9}{10} = \frac{72}{90} = \frac{4}{5}$. We lack the divisions of minor Third, and of major tone, in our adopted Greek scale, but we divide the minor tone into our two semitones, $\frac{15}{16} \times \frac{24}{25} = \frac{360}{400} = \frac{9}{10}$.

The first Greek who is known to have carried out the doctrine of super-particular ratios into all his scales is Didymus. He had been preceded by Archytas, and by Eratosthenes, but they did so only in part. Claudius Ptolemy followed after Didymus, but made the same one exception to this true principle as did Eratosthenes, by retaining the old Pythagorean Diatonic scale, among others, either out of respect for the name of Pythagoras, or because it was in general use. Nevertheless, each offered improvements upon it. Didymus[a] wrote a treatise upon the differences between Aristoxenians and Pythagoreans, of which we now know only some extracts, quoted by Porphyry in his *Commentary upon Claudius Ptolemy.*—(See, for instance, p. 210, edit. Wallis.)

As a scale designed for the Diatonic system of the Greeks, that of Didymus had some advantages over

[a] In the article written by W. A. Greenhill, M.D., for Dr. W. Smith's *Dictionary of Greek and Roman Biography*, the only Didymus, mathematician and musician, is dated as of the fourth century. Such a Didymus is to me unknown; but *the* Didymus is largely quoted, among others, by Claudius Ptolemy, who took astronomical observations at Alexandria, A.D. 139.

Ptolemy's arrangement, because both were intended for the minor scale. The difference between the two is but slight, the intervals being the same, and the scale of Ptolemy seemingly copied from that of Didymus, of which it is a mere transposition. In every Octave, two minor tones are necessary, one being required for each of the two Fourths, to make them consonant. Didymus placed one of his minor tones between C and D, and the other between F and G, while Ptolemy changed their places to between D and E, and between G and A, as we do now. In this last interval Ptolemy broke through the Greek law of having a full tone below *Mese,* or the key-note, but he could not make a novelty by any other means. Didymus obtained a perfect Fourth from A to D, a perfect minor Third from D to F, and a perfect Fifth from D to A. The imperfections of these intervals in our adopted scale have been a great perplexity to modern musicians.

But although Didymus had these advantages in a minor scale, they were outweighed by disadvantages when the key-note was changed in later ages from minor to major. To obtain due proportions for a minor scale, Didymus had made the Fifth from C upwards, and the Fourth from C downwards, both imperfect.

The advantages and the disadvantages of these two systems, which have been ranked as No. 1 and No. 2, by mathematicians for our present imperfect seven planet scale, will be best seen by placing them side by side, reminding the reader that every major Third, Fourth, and Fifth must have one minor tone, and but one, to be perfect.

In both scales, the disjunctive tone, A to B, was

necessarily major, according to Greek laws, but in the major scale of C, according to Nature's law, it ought to be a minor tone:—

SCALE OF DIDYMUS.

9 to 8	16 to 15	10 to 9	9 to 8	16 to 15	10 to 9	9 to 8
A to B	B to C	C to D	D to E	E to F	F to G	G to A

SCALE OF PTOLEMY.

9 to 8	16 to 15	9 to 8	10 to 9	16 to 15	9 to 8	10 to 9
A to B	B to C	C to D	D to E	E to F	F to G	G to A

The imperfections of the scale of Didymus are, that by having placed two major tones together, (G to A, and A to B,) he made a false major Third from G to B; also a false Fourth from G to C, because there was no minor tone in it; also a false Fifth from C to G, because he had two minor tones in it. Again, from B to D, and from E to G, are false minor Thirds, because they are made up with minor tones instead of major.

The imperfections of the scale of Claudius Ptolemy are, that from A to D is a false Fourth, from D to F a false minor Third, and from D to A a false Fifth. Also, that he has two different kinds of major Sixth, one from C to A, with two minor tones in it, and another from F to D, with one minor tone.

If Nature were called in to judge between the two mathematicians as to the true positions of major and minor tones, she would say that the one was right in the one place, and the other in another. Her law agrees with Ptolemy as to the intervals between C and D, and between D and E, but she wills a major tone between G and A, and a minor tone between A and B.

The above scale, by Claudius Ptolemy, to which he gave the name of "the tightly-strung Diatonic" (*Diatonon syntonon*), is the one adopted by the moderns. It is, perhaps, the best that has been devised for keyed instruments upon the inherently defective system of making a true Fourth from the key-note upwards. Even by Greek laws, the tetrachords began on the second note. A singer, or a fiddle player, may avoid the defects of a scale, but a pianoforte-player cannot alter the tuning of a note for any change of key. We are so thoroughly Greek in our system of music that it seems hopeless now to get rid of the prime defect of having the half of every Diatonic scale in one key, and the other half in what is misnamed its subdominant, or just a Fourth above it. It is that Fourth which makes our scale to be in two keys instead of one. Such is, therefore, the scale in which we are immediately concerned; and, with all deference to the Greeks, we may, perhaps, venture to look into its defects, as well as its advantages. We have one infallible guide to test it by, though it has been but little subjected to that kind of analysis. A thorough knowledge of our scale is a first requisite for a composer to make good harmony.

The preceding figures will have shown that the two tetrachords, B, C, D, E, and E, F, G, A, are equal—that their proportions are identical, (16 to 15, 9 to 8, and 10 to 9,) and that the one follows immediately upon the other—in fact, that they are equal conjunct tetrachords. The following scale of Nature will show that equal intervals, within two consecutive tetrachords, cannot arise from one root in a Diatonic scale, because Nature's Octave scale

diminishes proportions at each step, viz., a ninth, a tenth, an eleventh, twelfth, thirteenth, fourteenth, fifteenth, and sixteenth parts of a string.

That interval, from E to F, to which we give the name of major semitone, is the interval between a major Seventh and its Octave, and it therefore leads to its Octave, and makes F become the Octave and a new key-note. Then G becomes Second to F as its major tone, and A, which should be major, is lowered into a minor tone, to make it a Third to F. Thus the scale is changed from C to that of F.

Instead of all this, the minor Third from E to G being as 5 to 6, or 10 to 12, ought to have been divided by the true Harmonic F, an Eleventh, making the intervals 10 to 11, and 11 to 12. It is the change of the ratio of an Eleventh to a Sixteenth that brings F too near to E, and makes it touch so closely upon E sharp, that we actually omit E sharp in our scale. But E sharp is wanted in Nature's scale to make a Fifth and a Fourth to the Harmonic Seventh.[a] The two very wrong notes in this scale of Claudius Ptolemy's that we have adopted, are F and B flat. The ear has always told that they are defective, as will be further shown.

G, the Fifth, retains its place either way, but A ought to be a major tone above G. Then it would be a proper Second for the key of G, and a Fifth above D. It has been altered for the sake of making it a major Third above F, a Fourth above E, and a minor Third below C; but the alteration

[a] Our nomenclature for these notes is imperfect. E sharp will have to be called F flat to make a *Fourth* upwards to Harmonic B flat, or else the name by which the Harmonic Seventh is generally known must be changed. As there are eight Diatonic notes in Nature's scale, we require H after G, or else to number them from 8 to 16, which

takes it out of the key of C.[a] Nature does not provide a minor Third under her key-note, neither does she acknowledge such a "relative minor" as A. For Nature's relative minor to C, (if any scale can be so called,) we must look a Third above it, to E. According to Nature, every minor scale has its real key-note a major Third below it, so the key-note of A minor is F. In other words, a minor scale is merely one that is made to begin on the Third of the key. This will be seen further.

The law of Nature as to sounds is well known to practical men, and very simple. When a string is moved by a gentle breeze, its whole length is sounded, and, immediately afterwards, it divides itself into its aliquot parts, with quicker and quicker vibrations. These more rapid, but comparatively feeble vibrations overtake and mix with the slowly spreading waves of sound produced by the vibrations of the whole length of the string. When the velocity of the air is greatly increased, or, as we term it, "when the wind blows hard," the string is fluttered into many sections, and these shorter lengths move with multiplied rapidity of vibration to the whole length. This sensation of fluttering in parts will be sufficiently familiar to any one who has carried

would be the right names, and the semitones the odd numbers between 16 and 32. The following scale will exhibit this. If we had E sharp in our scale instead of F, we could then have the true B flat instead of the out-of-the-key interval to which our ears have been reduced, under that name.

[a] Our present A has the ratio of 5 to 3, but it is only to F, as a root, and not to C, as will be seen by reference to the following Harmonic scale, or scale of Nature. If C be the fundamental sound, the Octave C's will be 2, 4, 8, 16, 32, 64, all which are indivisible by 3, and our minor-toned A is not in the scale of C. But take F as the fundamental note, and then Nos. 3 and 5 will be our C and A, (like G and E in the key of C,) and give the required proportions; but in a different part of the scale. No. 3 will never be a key-note.

an umbrella in a high wind. The sections into which the string is then divided are caused by self-made nodes, or divisions, and these nodes are nearly quiescent points, and all equidistant. The number of sections increases as each division becomes shorter, while the pitch rises proportionably to their diminution in length. This diminution is caused by the increasing intensity of the wind. It is like the overblowing of a pipe, by which it is made to produce very high notes. As the sections become less, the united sounds become louder as well as more acute, because the higher the pitch the greater the number of sections emitting it. Supposing a string to be thus divided by nodes into sixteen parts, their pitch will be four Octaves above the fundamental note produced by its whole length. An extraordinary part of this arrangement of Nature is, that in every progression the whole of the nodes are changed. Thus, from sixteen, it divides into seventeen equal parts, from seventeen to eighteen, and so on.

So, too, when we blow into a horn, or pipe of any kind, with gradually increasing intensity and rapidity, we subdivide the column of air within the pipe, and raise higher and higher notes, just as the wind acts upon the string. In a flute, which is blown almost at a right angle to the column of air, and so the action of the breath becomes less direct than if it were blown at the end, the player may still draw eight different sounds from one fundamental note, or generator, without removing a finger to shorten the column of air. The lower the note upon which he may commence, the larger will be the number of Harmonics he can produce before reaching

the limit to possible increase of rapidity in breathing. The sounds so produced have three names. They are called "Natural Notes" upon a horn, and "Harmonics" upon a string; also, according to Helmholtz's nomenclature, "Overtones," because they are above the tone produced by the whole length of a string.

These Natural Notes, Harmonics, or Overtones, rise in the same order of succession as to musical intervals, from whatever fundamental note they may be derived. They do not vary in their order because the pitch of the fundamental note has been chosen high or low; and this may be proved, even when some of the low sounds may be too low to reach the ear. The one proviso for Nature's scale is that the string shall be uniform in size and quality, and the pipe be an open one.

For exemplification of these rising sounds the following table is subjoined. The fundamental note selected is C, two Octaves below C in the base staff, and the lowest C on a pianoforte. It is the C C C pipe of the open diapason of an organ. It is still popularly reputed to be "16 feet C;" but neither 4, 8, 16, nor 32 feet C are now so long as their names represent them to be. Owing to difference of scale and to elevation of pitch; also, perhaps, to insufficient pressure of wind for pipes of enlarged diameter, a nominal "32 feet C" is now about 28 feet 6 inches in length, with 15 inches in diameter, and "4 foot C" about 3 feet 7 inches long.

I have taken the pitch at 512 vibrations for treble clef C, as the only proper standard for musical pitch; because Octaves are the only continuously perfect intervals. Nature's Octaves are always multiplied

by 2 ; as 2, 4, 8, 16, 32, 64, 128, 256, 512. It is to be hoped that at some future time 512 vibrations will be made the standard pitch of Europe, by whatever name the note may be called. If the question of pitch in England had been left to the decision of the Royal Society, instead of the Society of Arts, 512 would undoubtedly have been the standard English pitch. In the Society of Arts, 512 was admitted to be the right pitch; but, for the accommodation of manufacturers, who feared that their stock of instruments might have been rendered unsaleable, the pitch of 528, exactly a quarter of a tone too high, was carried by a majority, and thus a temporary divorce between the science and the art of music was pronounced.

The French standard of 870 for A, and so of 522 for C, is a curious specimen of legislation. Neither of the two notes can be carried down two Octaves without fractions. Truly, we read of vibrations divided into fractions, but the art of accomplishing it has not yet been divulged. Where fractions are resorted to, the root is changed. The law excited strong remonstrance among scientific musicians against "le diapason normal malheureusement fixé arbitrairement." Handel's tuning fork gives from 499 to 500 vibrations. That of Mozart, and that of Berlin in 1772, (according to the report of the French Commission,) was 843 "half-vibrations" for A, instead of $853\frac{1}{3}$, which is the calculated pitch for A under the present system of tuning the Sixth; or 864, if the *true* A, (a Fifth above D,) allowing 512 for C. The later works of Haydn, and those of Beethoven, were composed for a pitch approximate to 512.

Considerations for private interests need not prevent the Society of Arts from giving notice of

future change. The members know what is right, but, influenced by good nature, have not yet acted up to their knowledge. Such a reunion of art and science as might thus be made, would be of at least equal benefit to art. If pianofortes can now bear a tension of 528, (and more) they can also bear thicker strings, and so can produce a better quality of tone at 512. The same rule applies to all instruments with strings, whether of wire or catgut. The plea of extra "brilliancy" by high pitch is a mistake; for brilliancy is not constituted by mere acuteness, but requires the addition of richness of quality in the tone. The practical effect now is, that the instruments in an orchestra are too thinly strung, and thus, richness of quality is sacrificed to acuteness. The violoncello has no longer the full tone that Lindley produced. Old violins were not made strong enough to bear the new tension, so, thinner strings must be resorted to. Thus, the works of the great masters are now inadequately represented. It is a case in which Germany and England should unite. In France, change must await the repeal of an eccentric law.

[a] The French count to and fro as *two* vibrations, and so their numbers are the doubles of these, therefore to be looked for an Octave higher.

[b] All notes within brackets differ in pitch from our scale. The reader may easily prove in figures how much our B flat is too sharp. From C to our F is a Fourth, and F to B flat another Fourth. Add the two Fourths together by multiplying them : $(\frac{4}{3} \times \frac{4}{3} = \frac{16}{9})$. Then Harmonic B flat is but $\frac{7}{4}$ to C. Deduct $\frac{7}{4}$ from $\frac{16}{9}$.

$$\begin{array}{rcl} 16 & : & 9 \\ 4 & : & 7 \\ \hline 64 & : & 63 \end{array}$$ (inverted 7 to 4).

[c] Harmonic F is 11 to 8 of C, and our F is only 4 to 3. Deduct the interval of 4 to 3 from that of 11 to 8, as above. Result, 33 : 32.

[d] E sharp (or F flat) is 21 to 16. Our F is 4 to 3. Deduct the former as before. Result, 63 : 64. There is another way of proving, by bringing them to a common denominator, say 48. Multiply $\frac{21}{16}$ by 3. Result, 63 forty-eighths. Multiply $\frac{4}{3}$ by 16. Result, 64 forty-eighths above C. Difference, 63 : 64.

THE MUSICAL SCALE OF NATURE;

Or, a Table of Natural Sounds, called Harmonics or Overtones, in the order of their ascent from any note of any pitch that may be the sound of the whole length of any string, horn, or open pipe. The swing to and fro of a pendulum is here counted as one vibration, according to the English meaning of a vibration.

	No.			Vibrations per Second.
	1.	CCC	Fundamental note, Generator, or Root...............	32[a]
	2. =	CC	Octave to No. 1. (Half length of the string)........	64
	3.	GG	Fifth No. 2, and Twelfth to No. 1......................	96
	4. =	C	in Bass clef—Fourth to No. 3, and Octave to No. 2	128
	5.	E	Major Third to No. 4...	160
	6.	G	Minor Third to No. 5...	192
	7.	[B♭][b]	Harmonic Seventh to C, flatter than our B♭ by a sixty-fourth part (*i.e.*, 63 to 64).......................	224
Scale of Eight Tones.	8. =	c	in Tenor clef—Octave to No. 4..........................	256
	9.	d	Major tone to No. 8..	288
	10.	e	Minor tone to No. 9..	320
	11.	[f]	Harmonic Fourth to No. 8 (sharper than our F by 33 to 32)[c]...	352
	12.	g	Fifth to No. 8...	384
	13.	[a♭]	Harmonic Sixth to No. 8 (sharper than our A flat)	416
	14.	[b♭]	Harmonic Seventh to No. 8, Octave to No. 7........	448
	15.	b	Major Seventh to No. 8, Fifth to No. 10, and Third to No. 12...	480
Eight Tones with their Semitones.	16. =	*c*	in Treble clef—Octave to No. 8, Minor Sixth to No. 10)...	512
	17.		Semitone above 16. (Too flat for our *d* flat).........	544
	18.	*d*	Octave to 9...	576
	19.		Semitone above 18...	608
	20.	*e*	Octave to 10	640
	21.	[e♯]	Semitone to 20, Fifth to 14, Harmonic Seventh to No. 12 (flatter than our F by 63 to 64)[d]......... ...	672
	22.	[f]	Octave to 11...	704
	23.	*f*♯	Semitone above Harmonic Fourth.......................	736
	24.	*g*	Fifth to 16, Octave to 12....................................	768
	25.	*g*♯	Semitone to 24, Major Third to 5, 10, and 20......	800
	26.		Octave to Harmonic Sixth, No. 13......................	832
	27.	[a]	Semitone to 26, Major tone to 24, Fifth to 9 and 18. (Our *a* is a Minor tone to 24)	864
	28.	[b♭]	Octave to 14...	896
	29.		Semitone above Harmonic Seventh. (Too sharp for our *b*♭)...	928
	30.	*b*	Octave to 15...	960
	31.		Semitone above *b*. (Too sharp for our *c*♭).........	992
	32.	*cc*	Octave to 16	1024

For notes a, b, c, d, *see preceding page.*

The scale might be carried further, into quarter-tones, but it is unnecessary to print it, because there is a simple rule by which any one may tell what the interval will be, and it applies to the division of all "super-particular" ratios, or such as differ only by one degree. Nature makes no fractions, but doubles the numbers, and interposes the one and only intermediate number. Thus, in the above division of the Fifth, No. 3, which is in the ratio of 3 to 2 of CC, No. 2, she doubles the ratio, viz., 6 to 4, and interposes the intermediate 5. Then, in the next Octave, this Fifth is divided into 6 to 5 and 5 to 4, minor Third and major Third. All odd numbers are new sounds; all even ones have before appeared in the Octave below. The numbers of the Harmonics are of importance in many ways. First, each indicates its proportion to the whole string, so No. 5 is a fifth part of the length, and No. 27 a twenty-seventh part, vibrating twenty-seven times as fast as No. 1; then, by multiplying the 32 vibrations of No. 1 by 27, we ascertain the vibrations of the latter to be 864 per second of time, or just as they stand in the table.

Again, multiply any number by 2, and we find its Octave; multiply by 3, for its Fifth, though an Octave too high; multiply by 5, for its major Third. Take the ratio of one number to another, as 21 to 14. These are as 3 to 2; therefore, the notes they represent are at the interval of 3 to 2, or a true Fifth. Take 9 to 12, or 12 to 16, the ratios are as 3 to 4; therefore, either pair is at the interval of a "Fourth." If 15 to 18, a true minor Third; and so on. Every number thus carries its musical ratio to all the rest.

These are mere hints of the value of the scale

of Nature, all evident upon the surface. It is for the musician to point out its deeper meanings.[a]

And now to try our adopted scale by this most ancient of all scales, and the one test of right and wrong. We find neither F, nor A as we tune it, in the Harmonic scale, when C is the root, because they belong only to a fundamental F. But we have the scale of G intimately connected with the scale of C. If our A were tuned a comma of Didymus higher than it is, viz., as a major tone instead of a minor tone above G, it would agree with Nature's No. 27, thus proving the scale of Didymus to be correct at that point. Ptolemy has mathematically calculated a Fourth above, and a Fifth below C, where no such intervals come from the root; and he has made the imported scale of the subdominant F more perfect by one degree than that of the true key-note. For instance, F has its Sixth (D) a major tone above its Fifth, although C, the nominal key-note of the scale, has it not. Transfer the name of key-note to F, and we may derive every interval of this so-called scale of C from F, except the B natural. As to B flat—that is from a third root—it belongs neither to C nor to F.

Nature's Octave scale agrees to this extent with the Greek, and therefore with our own, that each may justly be said to consist of a disjunctive or major tone immediately above the key-note, and

[a] If Professor Helmholtz would number his fundamental tone as No. 1, and let the first "overtone" be No. 2, instead of No. 1, a German reader would find the same advantage from his book, as an English reader may from this scale. In the meantime, he does not seem to have thought of the numbers as guides to harmony, although his book is intended to lay a basis for the theory of music—his No. 7 is our No. 8, and so on.

then of two conjoined tetrachords or Fourths. From C to D is the major tone, and from D to G and from G to C are the two Fourths. The difference is in the filling up of those two Fourths. It has been said already that F and B flat are two essentially wrong notes for the key of C. Also, that A should be a major tone above G, instead of minor, as it now is; and that E sharp has been omitted in our scale only because we have a wrong F brought too close to it. Our F is only a 64th part of a string above E sharp, and is a 33rd part below the F of Nature. Again, if we had the true instead of the artificial B flat in our scale, the semitone that we omit above E would harmonize as a true Fifth above it. Our B flat is just as much above the real note as our F is above the true semitone to E. We omit three Diatonic notes out of eight, viz., Nature's Fourth, Sixth, and Seventh; for A is but one of the semitones between the Sixth and Seventh in Nature's scale, and it ought to be a true Fifth above D.[a] Our B natural would then be the eighth tone in the scale, if the key-note were still counted as No. 1, and we admitted eight, as in Nature.

The special disadvantage of our adopted F and B flat is the impossibility of having more than four consecutive notes in one key while we include them. Even to have four, we must begin with the major Seventh, as B, C, D, E. Our B flat belongs neither to the key of C nor that of F; for, just as there is no such Fourth as F from the root of

[a] As the real A is No. 27, its true Fifth (multiplying by 3,) must be the sound of 81. It cannot be found nearer, because 27 is an odd number, and all odd numbers are new notes.

C, so neither is there any such Fourth as B flat from the root of F. The Harmonic B flat that we omit has the major-toned A (No. 27) as its semitone, on the one side, and the B natural of our scale (No. 15 or 30) as a tone, on the other side, to divide it from the Octave. Its ratio of 7 to 6 of the Fifth makes it the interval next in the order of consonance to a minor Third.

And now as to the constitution of CONSONANCE and DISSONANCE, two words which, although they carry their own interpretations as "sounding with," "and sounding apart," have, nevertheless, been misapprehended; and one of the two causes of consonance has been but little taken into the general account.

Degrees of consonance depend upon the proportion that coincident vibrations bear to those which "sound apart." The unison alone is perfect consonance, because therein only do all vibrations coincide. Their simultaneousness is rigidly exact, whether sounded upon the unison-strings of a pianoforte, or upon the many instruments of an orchestra, with their varied qualities of tone. Only in intervals is there any intermingling of coincident and non-coincident vibrations. The unison is not an interval.

In order to abbreviate explanations, I refer to the Harmonic scale at p. 217. Nos. 1 and 2 are an Octave apart. The first has 32 and the second has 64 vibrations per second of time. Therefore, No. 2 vibrates as 2 to 1 of No. 1, and the first of every two vibrations of No. 2 coincides with one of those of No. 1, while the remaining 32 of No. 2 "sound apart."

Again, Nos. 2 and 3, or double C and double G, are at the interval of a Fifth, and No. 3 vibrates 96 to the 64 of No. 2—or in the proportion of 3 to 2. The first of every two vibrations of No. 2 coincides with the first of every three vibrations of No. 3. So, there are still but 32 coincident vibrations. Divide 64 by 2, and 96 by 3 to prove it.

One more example from Nos. 3 and 4. Here the total number of vibrations is 96 to 128, but it is the first only of every three of the one that coincides with the first of every four of the other. Therefore, the number of non-coincident vibrations has progressed, while the original number of 32 coincident vibrations has remained stationary. For that reason the interval of the Fourth, or 4 to 3, is less consonant than that of the Fifth, or 3 to 2; just as the interval of the Fifth, 3 to 2, is less consonant than that of the Octave, 2 to 1.

This natural law may be carried throughout the scale, wherein dissonant vibrations increase, between consecutive numbers, at every ascending step, while the consonant remain stationary. So the lower the two numbers, the more consonant the interval. Still, it is a necessary proviso for consonance that the sounds be derived from one root, as in this scale.

To take a last example from 15 and 16. They represent the interval of a major semitone in every Harmonic scale. Here it is from b to c. The numbers of vibrations are 15 times 32 of the one, to 16 times 32 of the other. But as only the first of every 15 coincides with the first of every 16, there are still but 32 coincident vibrations to leaven the mass of dissonance. So the ear pronounces the

interval from b to c, when simultaneously sounded, to be exceedingly harsh and disagreeable. Nevertheless, the two sounds are absolutely required for melody.

Hence follows a rule—that, whatever may be the aggregate number of vibrations in a second of time from the fundamental note, or entire length of a string—whether it be of such a length as to give 32, 33, 132, 133, or any other quantity—the same will be the number of consonant vibrations between every two succeeding sounds of the scale. The intervals follow invariably in the same succession, and are, therefore, represented by the same numbers in every Harmonic scale. Hence any two numbers indicate the proportions of an interval, just as every one number indicates its proportion to a whole string.

Again, a second rule. Consonant vibrations are equal to the *difference* in the *total number* of vibrations between every two succeeding sounds—for just as 32 is the number of consonant vibrations in the fundamental sound of this scale, so 32 is the difference between the vibrations of every two succeeding numbers throughout the scale. If the same interval be taken an Octave higher, the same *proportion* is observed, but the vibrations are completed in half the time. Thus in the Octaves, 1 and 2, with 32 and 64 vibrations, and 2 to 4, with 64 and 128; the the vibrations of the later are doubled in rapidity as they are in number. So they only perform in half a second of time what the others do in a second.

Coincident vibrations are strengthened beyond others by their perfect agreement, just as in the case of two hammers striking at the same instant.

The united sound is then louder than if the blow of the one were to follow immediately after that of the other.

Coincident vibrations, having thus a superior power, mark a musical rhythm combining sounds of different pitch. It is this *rhythmical coincidence* which constitutes the charm of harmony in its different shades, for harmony has always a certain amount of dissonance embodied in it. The unison alone is free from all dissonance. Rhythm is the first in order of the pleasures derived from music. It suffices wholly for the savage, with his monotonous tom-tom beats; and, except as to the Harmonic sounds evolved, it is the only gratification that the ear can receive from such instruments of percussion as yield but a single note—such as a drum, cymbals, or castanets. In harmony, we enjoy the effects of rhythm enhanced by a combination of various sounds that differ in pitch, and we derive further pleasure from the varied qualities of tone that are produced by the many instruments of an orchestra. The due appreciation of so many simultaneous sounds is a reward reserved for those who have cultivated their powers of hearing. A peasant will better understand the single sound of a fiddle or of a flute. Some ears remain uncloyed by the perpetual sugar of successive unisons, while others have a greater appreciation for varied harmony. Of the latter, some have also a taste which indulges largely in an admixture of spice, in the form of discords.

The rhythm of coincident vibrations between two sounds is often audible in the separate form of a third sound. The conditions are, that the vibrations of the two originating sounds shall be sufficiently

rapid, and they must, therefore, necessarily be high in the scale. If otherwise, they will not admit of consonant vibrations in sufficient number within a second of time to form themselves into an audible musical note. If too few, the resultant tones are indistinguishable from the general sound. Another condition is, that the two primaries shall be sufficiently loud to bring out the feeble sound of the resultant tone. A few examples of these will be cited from practical experience in the sequel.

The second source of consonance to which I have adverted is in the Harmonic sounds which follow immediately after the notes of pipes, of strings, and of voices, and which thus serve to enrich their tones. If two sounds be combined, the lower will produce greater effect, and this is particularly manifest in the case of the wider consonant intervals. Thus, between Nos. 1 and 4 of the Harmonic scale the interval is a double Octave. When No. 1 is sounded, it throws out its Harmonics, 2, 3, 4, 5, 6, and they enrich the consonance with No. 4. Upon keyed instruments, Octaves are usually the only intervals thus enriched, because, in all cases, Octaves are tuned perfectly, but, in too many cases, other intervals are tempered, *i.e.*, put either a little, or not a little, out of tune. Unless the tuning be perfect, Harmonics militate against, instead of strengthen consonance.

I have been thus minute in detailing the causes of consonance and of dissonance, because a theory, as to their partial dependence upon a fixed number of vibrations has been propounded by the learned Helmholtz, Professor of Physiology in the University of Heidelberg. His view has been widely disseminated through *Lectures on Sound*, delivered by

Professor Tyndall at the Royal Institution of Great Britain. The lectures have been published, and having reached a second edition, in which this definition is repeated, the objections to Helmholtz's view require to be pointed out. It is the more necessary, because the lectures have been largely adopted as authoritative upon sound, just as might have been expected from the varied knowledge and the high reputation of its author.

Professor Tyndall says, "Beats, which succeed each other at the rate of 33 per second, are pronounced by the disciplined ear of Helmholtz to be in their condition of most intolerable dissonance."—(p. 295.)

In order to represent this theory, derived from Helmholtz, in the fairest way, I extract one of the paragraphs from his *Tonempfindungen*. The original words are at the foot of the page, and the following is a very literal translation[a]:—

"The interval, $b\natural'$ c″, gave us 33 fluctuations in a second of time, which make the united sound very grating to the ear. The interval of a whole tone, $b\flat_1$ c_2, yields nearly double the number, but these are much less grating than those of the first-named narrow interval. Finally, the interval of the minor Third, a' c'', should, according to computation, yield 88 fluctuations in the second; but, in fact, the latter interval allows us to hear scarcely anything of the roughness which the fluctuations of the

[a] "Das Intervall, h' c'', gab uns 33 Schwebungen in der Secunde, welche den Zusammenklang scharf schwirrend machen. Das Intervall eines ganzen Tones, b_1 c_2, giebt nahe die doppelte Anzahl, diese Endlich solte uns das Intervall der kleinen Terz, a' c'', der Rechnung nach 88 Schwebungen in der Secunde geben; in der That lässt aber das letzere Intervall kaum noch etwas von der Rauhigkeit hören, welche die Schwebungen der engeren Intervalle hervorbringen. Man könnte nun

closer intervals produce. Now, it might be supposed that it is the increasing number of fluctuations which obliterates the impression, and makes them inaudible. For this supposition we should have the analogy of the eye, which is likewise no longer able to separate a series of quickly following impressions of light when the number is too great. Take, for example, a burning coal swung round in a circle. When it describes a circuit from 10 to 15 times in a second, the eye imagines that it sees a continuous fiery circle. So, also, with the disk of colours, the appearance of which is known to most of my readers. When such a disk rotates more than 10 times in a second, the different colours on it are blended into one fixed impression of their mixed colour. It is only by very intense light that quicker changes of the various fields of colour must take place" [to be distinguishable] "20 to 30 times in a second. Thus, in the case of the eye, a similar phenomenon takes place as with the ear. When the change between irritation and rest takes place too rapidly, the

vermuthen, das es die wachsende Zahl der Schwebungen sei, welche ihren Eindruck verwische und sie unhörbar mache. Wir würden für diese Vermuthung die Analogie des Auges haben, welches ebenfalls nicht mehr im Stande ist, eine Reihe schnell auf einander folgender Lichteindrücke von einander zu sondern, wenn deren Anzahl zu gross wird. Man denke an eine im Kreise umgeschwungene glühende Kohle. Wenn diese etwa 10 bis 15 Mal in der Secunde ihre Kreisbahn zurücklegt, glaubt das Auge einen continuirlichen feurigen Kreis zu sehen. Ebenso auf den Farbenscheiben, deren Anblick den meisten meiner Leser bekannt sein wird. Wenn die solche Scheibe mehr als 10 Mal in der Secunde umläuft, vermischen sich die verschiedenen auf sie aufgetragenen Farben zu einem, ganz ruhigen Eindrucke ihrer Mischfarbe. Nur bei sehr intensivem Licht muss der Wechsel der verschiedenfarbigen Felder schneller, 20 bis 30 Mal in der Secunde, geschehen. Es tritt also beim Auge eine ganz ähnliche Erscheinung wie beim Ohre ein. Wenn der Wechsel zwischen Reizung und Ruhe zu schell geschieht, so verwischt sich der Wechsel in

change is obliterated in the perception, and rest becomes continuous and uninterrupted."

"But we may convince ourselves in the case of the ear, that the increase in the number of the fluctuations is not the only cause of their obliteration in the perception. Thus, when we passed from the interval of a semitone, *b*♮′ *c*″, to that of a minor Third, *a*′ *c*″, we have not only increased the number of the fluctuations, but also the width of the interval. But we may also increase the number of the fluctuations without altering the interval, by transposing the same interval into a higher region of the scale. If, instead of *b*♮′ *c*″, we take the same two notes an Octave higher, we obtain 66 fluctuations, and if yet an Octave higher, even 132 fluctuations, and these are actually audible in the same manner as the 33 fluctuations of *b*♮′ *c*″, though indeed they become feebler in the very high Octaves."—(pp. 269, 270.)

I have quoted Helmholtz's words at full length, to show how the second part of his argument militates against the first. In the second part, he

der Empfindung, die letztere wird continuirlich und anhaltend.

"Indessen können wir uns beim Ohre zunächst davon überzeugen, dass die Steigerung der Zahl der Schwebungen nicht die alleinige Ursache davon ist, dass sie in der Empfindung sich verwischen. Indem wir nämlich von dem Intervall eines halben Tones, *h*′ *c*″, zu dem einer kleinen Terz, *a*′ *c*″, überbringen, haben wir nicht bloss die Zahl der Schwebungen, sondern auch die Breite des Intervalls vergrössert. Wir können aber auch die Zahl der Schwebungen vergrössern, ohne das Intervall zu verändern, indem wir dasselbe Intervall in eine höhere Gegend der Scala verlegen. Nehmen wir statt *h*′ *c*″, die beiden Töne eine Octave höher, *h*″ *c*‴, so erhalten wir 66 Schwebungen, in der Lage *h*‴ *c*⁗ sogar 132 Schwebungen, und diese sind wirklich hörbar in derselben Weise, wie die 33 Schwebungen von *h*′ *c*″, wenn sie auch allerdings in den ganz hohen Lagen schwächer werden." — (*Die Lehre von den Tonempfindungen, als physiologische Grundlage für die Theorie der Musik*, von H. Helmholtz, Professor der Physiologie an der Universität zu Heidelberg, 3rd edit. 1870. 8vo, pp. 269, 270).

gives a case in which 33, 66, and 132 fluctuations are equally dissonant; and that alone should prove that dissonance follows this interval, and does not depend upon 33, 66, or 132 fluctuations. But Helmholtz has mistaken the character of these fluctuations, (Schwebungen,) and to that cause must also be attributed the indefinite name he has given them. They are nothing but the coincident and consonant vibrations. It is strange that he should have so mistaken them as attribute dissonance to consonant vibrations, instead of to the exceeding number of dissonant vibrations that are mixed in the interval from b♮ to c.

That I may not misrepresent Helmholtz, I again give his words. At p. 258, he says, "The number of fluctuations within a given time is equal to the difference in the total number of vibrations (Schwingungen) which the two sounds execute in the same time."[a] That is a precise definition of consonant vibrations, and it can be of no other. The same number runs throughout a scale in more or less rapid succession, whether the interval be Octave, Fifth, Fourth, Third, or any other.

The mistake in the character of "fluctuations" has led Helmholtz to propound a new doctrine as to the cause of resultant sounds, to which I shall have occasion to refer hereafter.

This eminent acoustician did not sufficiently regard the musical bearings of the Harmonic scale when he proposed to lay a basis for the theory of music. That part of the subject has been too much

[a] "Die Zahl der Schwebungen in einen gegebener Zeit findet sich also gleich der differenz in der Anzahl der Schwingungen welche beide Klänge in derselben Zeit ausführen."—(p. 258.)

neglected by many writers on music. Helmholtz, through his system of numbering by overtones instead of by the lengths that produce them, has missed the advantages that the proportion-numbers of the scale would have conferred, and has himself been led into such slips as to attribute to *cc* and *dd* 18 and 20 "fluctuations," instead of to *dd* and *ee*—(p. 259). As only the ninth and tenth vibrations coincide in the example which he has given, the numbers must be our 9 and 10, or their doubles. C cannot have 18, neither can D have 20 fluctuations, when the fundamental note throughout the book is C C C, at the German pitch of 33 vibrations.

For the reasons above given, I demur equally to the doctrine in Professor Tyndall's *Lectures on Sound*, that, while "dissonance is at its maximum when the beats number 33 per second, it lessens gradually afterwards, and entirely disappears when the beats amount to 132 per second"—(p. 296). If the full length of the string be about four feet, and give 132 vibrations, there will be 132 in every following interval, consonant or dissonant.

Again, writers upon the science of music have for a long time assumed as an admitted fact, that the numerous sounds which result from the Harmonics of a string, or pipe, are not only emitted collectively and superposed, but also simultaneously with those of the entire string. There would indeed be a jargon if it were so—let any one fancy half the keys of a pianoforte down at once. Then, following out this theory, they attribute all the various qualities of tone inherent in musical instruments, whether by wind, by string, or by percussion, to differences in their Harmonics.

So very general has been the submission to these assumed laws, down to the present time, that some may be astonished that I should throw even a doubt upon them. Nevertheless, both the eye and the ear give evidence against such doctrines. The test of the ear is within everybody's reach.

For instance, strike one of the lowest keys upon a grand pianoforte smartly, and raise the finger instantly, so that the damper may fall heavily upon the string. The harder the damper, the more patent will be the fact that the Harmonics are not simultaneous, but consecutive. Each successively rising note may be identified by a cultivated ear, upon an old grand pianoforte, and even the uncultivated can distinguish the progressively rising sounds, and that the highest note of all is the last.

This order would be reversed if the sounds were emitted simultaneously, because, the higher the note, the sooner will its rapid vibrations be completed. To prove it, touch a base and a treble string of a pianoforte at the same instant.

Again, as to the Harmonics produced by the human voice. Regnault's recent experiments upon propagation of sound through long water pipes may be cited to establish the same order in their succession. The results of these experiments are published in the Appendix to Professor Tyndall's *Lectures*. The following is an extract:—

"V. Experiments made with waves produced by the human voice and by wind instruments have demonstrated these principal facts. Acute sounds propagate themselves with much less facility than grave sounds. In very long conduits, to hear well, it is necessary to employ a baritone; *the funda-*

mental sounds are heard before the Harmonics, which then succeed each other in the order of pitch. The propagation of the sound *changes* its timbre, which is due to the admixture of the Harmonic sounds. In very long conduits, therefore, a tune embracing a certain extent of the gamut would change its character."—(p. 329.) These long conduits are the best proof, because the sounds are concentrated by them.

So far for the ear, and next as to the eye. Not only may a quick eye see the diminishing nodes upon a pianoforte string when it changes its Harmonics, but Kundt's experiments have proved them to demonstration. He strewed the light dust of lycopodium within a glass tube, and made the glass emit its various Harmonic notes by employing slower or quicker friction. His experiments were exemplified by Professor Tyndall in his fifth lecture, and were therefore witnessed by large audiences, composed of those who take an interest in science. With every ascending sound, the dust was seen to arrange itself into a greater number of equal divisions. The length of every section in the tube was changed just as every sound was changed. Indeed, it might have been predicted; because Harmonics are only produced by aliquot parts of a string, or of a column of air. Every division of a string into *equal* parts will produce an Harmonic note, but the scale must teach where to place it.

Thus, both the ear and the eye, assisted by the pipe, the string, and the voice, bear testimony against the simultaneous projection of Harmonics.

As to the duration of sounds emitted, one important cause has not been sufficiently taken into

account. It is the after-current which follows upon every displacement of air, however minute that displacement may be. The vibrations of the air thus continue, as in echoes, after the exciting cause has ceased. The longer the string, the wider is its range of vibration; and, therefore, the greater the disturbance. The effect of the displacement is felt on a grand scale in the after-current which accompanies the discharge of a cannon. Not only the concussion, but also the rush of air, are sensibly felt by all who are behind or near to it. We have again the best practical evidence of the sound-waves which pervade even the seeming stillness of the air, when we hear them concentrated and intermixed within the hard and polished windings of a shell, by raising it to the ear.

And now, as to the theory which has been supposed to account for difference of tone in numberless musical instruments.

Professor Tyndall says, "It is the addition of such overtones to fundamental tones of the same pitch which enables us to distinguish the sound of the clarionet from that of a flute, and the sound of a violin from both. Could the pure fundamental tones of these instruments be detached, they would be indistinguishable from each other; but the different admixture of overtones in the different instruments renders their clang-tints diverse, and therefore distinguishable."—(p. 127.)

In the first place, a flute, a pianoforte, a violin, and a hautboy, have the same Harmonics; but very different are their tones. In the second place, pure fundamental tones are always detached in harmoniums, because they have *no* audible Harmonics. This is perhaps owing to their being made with

tapering springs. Yet different qualities of tone are sensibly produced from the different stops of harmoniums, and every ear can distinguish between them. Again, take three wooden open pipes of an organ, of equal length, but, one of a square shape, the second with the proportions of 3 to 2 in superficies, and the third of triangular form; they have the same Harmonics, but all differ in tone. If facts of this kind cannot be gainsayed, surely the two theories must fall together.

I here touch upon acoustics only so far as they are strictly related to music, and thereby run into my path. Upon other, even allied branches, I have nothing now to say.

The practical range of the ear for adequately distinguishing *musical* sounds does not far extend beyond the seven Octaves of a pianoforte, or else more notes would have been commonly added by the manufacturers. An eighth Octave gives very indefinite sounds to most ears, and even the extreme notes of the seven Octaves are not easily distinguishable unless their Octaves are sounded with them, to make them definite. The advantage of an eighth Octave consists in this, that it increases the quantity of tone, and gives the richness of its Harmonics to the others.

The six-octave scale of Nature is as follows:—First, the note and its Octave only. Second Octave, divided into a Fifth and a Fourth, afterwards providing an equal number of intervals for each of the two divisions. Third Octave, divided into four Thirds, of which we employ only two, and change the character of the lesser two, by having omitted the Harmonic Seventh that divides them.

FOURTH OCTAVE, eight tones of gradually diminishing interval, of which we employ only the largest two and the least, but entitle the least a "Diatonic semitone." FIFTH OCTAVE, the same eight tones as before, with their eight intermediate semitones. SIXTH OCTAVE, tones, semitones, and quarter-tones.

The Harmonic scale was only developed during the last century, and was scarcely thought of in the theory of music until the present. The discovery which led to its formation was made by two graduates of Oxford, about the year 1673. It was communicated to Dr. John Wallis, the celebrated mathematician, in 1676; was first made known by him in the English edition of his Algebra, in 1685, and subsequently in the Latin edition of his Mathematical Works, in 1693.

Dr. Narcissus Marsh, founder of Marsh's Library in Dublin, and an exemplary prelate, who was successively Archbishop of Dublin and of Armagh, was residing in Oxford in and before 1676. Dr. Marsh was a great lover of music, and especially of part-music, both vocal and instrumental. These two branches were then much cultivated by members of the University, and Marsh's chief relaxation was in private concerts with certain of them, either at his own, or at their rooms. In 1676 he informed Dr. Wallis, the Savilian Professor of Geometry, that about three years before that date, two of his friends, William Noble of Merton College, and Thomas Pigot of Wadham College, had discovered a means of producing, at command, the Harmonics or natural notes from a vibrating string, and this to all appearance simultaneously, and without intercommunication.

Before that time, little seems to have been known

beyond the facts that, if two strings are tuned in unison, and the one be struck at no great distance from the other, the second string will sound with the first; and, secondly, that the wind will produce weird sounds from the strings of a harp exposed to its effects. The same amount of information was shared by the ancient Greeks, and, among the earlier moderns, by St. Dunstan.

The natural notes of a trumpet, or of a horn, could not be measured; therefore it is of some importance to have discovered that, if one of the aliquot parts of a string be touched very lightly, while the string is under the friction of a bow, it will divide itself into nodes, and give the Harmonic, instead of the fundamental, notes.

It has proved to be of more importance than Dr. Wallis seems to have anticipated; for, although he turns sensibly out of his path to record it in his Algebra "lest the remembrance should perish,"[a] he states it more as a natural curiosity than as of advantage to science.

The discovery lay fallow for half a century, and was then taken up by Dr. Brook Taylor, who was the first to publish analytical researches into the vibration of strings.[b] Thenceforward, successively, by Bernouilli, Euler, Lagrange, d'Alembert, Riccati, Dr. Matthew Young, and by the illustrious Chladni, down to the eminent mathematicians of the present century.

It will be an advantage to composers to consider the difference of the several roots in every key, when they are writing for performances in large buildings

[a] "ne pereat."—(Wallis's *Opera Mathematica*, vol. ii. p. 466, fol. 1693.)

[b] *Methodus Incrementorum directa et inversa* auctore Brook Taylor. 1715.

of resonant and Harmonic-giving qualities. They must often wish to avoid the conflict of discordant Harmonics, since grandeur of effect will, in a great measure, depend upon care in that respect. Every semitone, and even every quarter-tone, in the Harmonic scale, may be used in melody without preparation, and without going out of the key.

"The sense of harmony," says Sir W. Herschel, "depends upon the periodical recurrence of coincidental impulses on the ear, and affords, perhaps, the only instance of a sensation for whose pleasing impression a distinct and intelligible reason can be assigned."[a] This passage is quite the antithesis to the definition of Helmholtz, that coincidental impulses may be causes of dissonance.

Harmony now means, both technically and truly, a mixture of concords with discords, both of which are included in the Greek word *Harmonia.* If Herschel had intended consonances only, according to the popular idea of harmony, he would have limited his definition to "coincidental impulses on the ear, derived from a common root."

Very different are the effects of the same interval in two places. What singer has not observed how much more natural and agreeable it is to sing a Fourth either up to, or down from, the key-note, than the same interval taken from the key-note to a Fourth above it? The reason is that, in the last case, he goes from one key into another. Again, the minor Third, when in its right place, is one degree more consonant than the interval between the Fifth

[a] Quoted by J. H. Griesbach, in his *Analysis of Musical Sounds*—(p. 32)—from Sir John Herschel's *Preliminary Discourses on the Study of Natural Philosophy.*

and the Harmonic Seventh; but, if in the key of C, we sing or play ascending C, E, G, Harmonic B flat, B natural, and C, we have an agreeable melodic passage;[a] whereas, if we substitute for Harmonic B flat, our B flat, which is a minor Third to the G, and so play C, E, G, B flat, the ear will not allow us to ascend further—we are driven back upon A by the discord of B flat.

The system of subdominants is Greek, but not Nature's. We sacrifice too much for the sake of making one extra interval of a perfect Fourth from the key-note to its Fourth above, which Nature does not allow. Her perfect Fourths are from the Second and Fifth of the key upwards, as from D and G in the key of C. Defects of this kind were less forcibly observed by the old musicians than now, because they did not test the scale by that of Nature; but ears, ancient and modern, have always been protesting that these notes are wrong.

The protest against the two notes, Fourth and minor Seventh, commenced in very remote antiquity, we might say, in ancient Egypt, on the assumption that Pythagoras derived his scales from Egypt, of which there is hardly a doubt. It seems impossible to attribute the peculiarity of the Greek Chromatic scale, in its passing down from the Octave, over the Seventh; and then from the Fifth, passing over the

[a] The principal intervals of the Harmonic scale are not only theoretically, but also practically, familiar to me, from having, (as in duty bound, before writing on the subject,) drawn out a scale, from which a monochord was constructed under the superintendence of Mr. Kemp. I had then the opportunity of trying the intervals in various ways upon a pianoforte tuned by the monochord. The real effect of unfamiliar sounds is not arrived at by testing them alone upon a monochord. They gain immediately upon being tried in their proper places. For a bold melodic progression, try E, Harmonic F, and G.

Fourth; to any other motive than that of avoiding those intervals which their ears told them were out of the key. Again, the same two notes were picked out for omission in the Greek Enharmonic scale, which, Plutarch tells us, had its origin in the desire of Olympus to avoid the minor Seventh. It is also sure that Olympus, or whoever invented that system, equally rejected the Fourth; for no ancient Chromatic or Enharmonic scale includes either the one note or the other. Similar instances may be noticed among the moderns—as in the universal rejection of the Seventh in the ascending minor scale, and in the substitution of the major Seventh, which the ear has judged to lead so definitely to the Octave, that it received from the French the name of "la note sensible;" or, in the words of Rousseau, "parcequ'elle annonce la Tonique et fait sentir le Ton." Again, in the rejection of both Fourth and minor Seventh by the musical ears[a] of the composers of old

[a] It would be an advantage to music if there were a larger preponderance of such ears at the present time. With many evidences, ancient and modern, of the guidance of the ear to what is right, it is regretful that, owing to the imperfections of keyed instruments, we should be driven to adopt the system of tuning called Equal Temperament. Tempering is to be "just so much out of tune as the ear will bear." The consideration of sounds that will give most pleasure to the ear does not enter into the arrangement. There are some ears that will bear a great deal of "tempering," and they must have been especially consulted as to the tuning of the Thirds in the new system. Sustained harmony in Thirds is now disagreeable to sensitive, as well as to educated, ears, instead of affording them any pleasure. If singing-masters should be led to adopt such tuning as this for their pianofortes when they are teaching pupils to sing, they can hardly expect the pupils to sing correctly, and will have tenfold trouble in trying to instil into them the imitation of imperfect sounds. The one recommendation of the system is, that it enables the pianoforte player to have the command of twelve keys; and, as his instrument does not sustain tone like the organ or harmonium, equal temperament passes muster with a greater number of persons. But they do not derive equal pleasure from the music, although

popular ballads, Scotch and Irish. There are many English airs of the same class, but they were not included in *Popular Music of the Olden Time*, because the public voice would probably have attributed them to Scotland or to Ireland; also because there was already too large a number of English airs for publication in one selection. Other countries have tunes remarkable for the same omissions. Mathematical science alone will not teach that the two intervals are wrong, but the true science of music rests upon the investigation and following out of the laws of Nature, and does not sanction any conflict with those laws.

According to one learned writer upon the mathematical branches of music,[a] there was a true scale in use from the time of Monteverde or Caccini. It

unable to point out the cause. The advantage of twelve keys is counterbalanced by having them all out of tune and without any redeeming variation of character. It is an attempt to do too much upon imperfect instruments. The greatest benefactor would be he who could invent mechanism by which a pianoforte, in tune in one key, could be raised by pedals to others, and remain in tune there also. It is not a shifting movement that is wanted, but one that shortens the strings. Till then, we can make something out of difference of character. "Il est bon d'observer," says Rameau, "que nous recevons des impressions differentes des intervalles à proportion de leurs differentes altérations. Par examples la Tierce majeure qui nous excite naturellement à la joie, nous imprime jusqu' à des idées de fureur quand elle est trop forte, et la Tierce mineure, qui nous porte à la tendresse et à la douceur, nous attriste lorsqu'elle est trop foible." There is a character in every interval, derived from the coincidental vibrations that give a sort of rhythm it.

[a] "La vraie gamme majeure de la tonalité moderne, depuis l'innovation de Monteverde ou Casini, s'exprime par les rapports : 16, 18, 20, 21, 24, 27, 30, 32." (Compare the numbers by the preceding Harmonic scale.) "Elle n'est pas conforme à celles données par la généralité des didacticiens—les leurs devaient infailliblement égarer tout spéculateur contemporain — Cette gamme seule contient l'harmonie consonnante et dissonante entre elles conjointes par un égal *terme appréciable de comparaison*, qui nous inspire un sentiment unique de tonalité," &c.—(*Calcul Musical et Philosophie de la Musique* par Charles Meerens, p. 20. 8vo. 1864.)

had the F lowered by a sixty-fourth part, so really changed it into E sharp, and it had the true A (27 to 16). He does not allude to the Harmonic B flat which should have followed upon this arrangement, so as to make true Fourths and Fifths with this semitone above E, because he there writes only of a Diatonic major scale. But the partial adoption of the Harmonic scale is confirmed by the ancient use of trumpets and horns without keys. They were formerly very important instruments in out-door music, and could not be played upon in any other scale than that of Nature until keys or valves were invented for them. So it appears that the moderns have really retrograded, and have gone away from Nature in the present scale. The reason for employing the semitone above E, to make an F, was evidently to keep as near as Nature would permit to the present scale. One grand objection to a tempered scale is, that it makes false Harmonics, as well as false notes. Richness of tones depends much upon Harmonics.

The mixture-stops of an organ are solely for the purpose of supplying the Harmonics which are deficient in stopped pipes, and there can be no grandeur of effect in an organ without those mixture-stops. But there are organ builders who do not seem to know that such stops are to be voiced softly, and organists who forget that they are only to be used with the full organ, so that their tones may be covered by the volume of other sounds. If made prominent, they produce a disagreeable, instead of a grand effect.

The stopped pipe of an organ is merely a pipe with a plug at the end, or cap upon it, so that the

wind has to travel to and fro to obtain an exit at the open lip, or notch. The column of air is thus doubled in length, and the note produced is therefore an Octave lower than that of an open pipe. A clarionet is of the nature of a stopped pipe, and although closed only at the end next the mouth, the effect of lowering the tone by an Octave is the same. One foot in length of the clarionet produces the same C as two feet in length on a flute. Only two Harmonics can be produced from a clarionet, viz., a Twelfth, and another Twelfth above it—the latter, with difficulty, on account of its high pitch. The peculiar Harmonics of the clarionet were first brought into notice by Sir Charles Wheatstone, F.R.S. Professor Tyndall says, that the clarionet has the Harmonics 1, 3, 5, 7, by opening the holes at the sides. But to do so is to change the fundamental note.

Professor Tyndall gives a useful second rule for comparing intervals, only in terms that may not be understood by every reader without a line of explanation. He gives the notes of the scale of C thus:—

"Names, . . .	C,	D,	E,	F,	G,	A,	B,	C.
Rates of vibration,	1,	$\frac{9}{8}$,	$\frac{5}{4}$,	$\frac{4}{3}$,	$\frac{3}{2}$,	$\frac{5}{3}$,	$\frac{15}{8}$,	2."

and then says: "Multiplying these ratios by 24, to avoid fractions, we obtain the following series of whole numbers, which express the relative rates of vibration of the notes of the Diatonic scale:—

24, 27, 30, 32, 36, 40, 45, 48."

To multiply the ratios, means to multiply each upper number by 24, and divide by the under, as in the case of fractions. This rule may be preferred by some to the one I have given at page 200, and,

for musical purposes, the one is as efficient as the other.

But, for those who are versed in mathematics, it should be pointed out that the use of the logarithms of the intervals very much simplifies calculations, as then all the multiplication, the bringing to a common denominator, &c., is entirely dispensed with. The logarithms, in fact, exactly represent to the eye what the intervals do to the ear, and we have only to deduct or compare the logarithms on paper, just as the ear does when the corresponding intervals are heard.

For example, taking two kinds of tetrachord: their composition is at once clearly illustrated by the following simple statement, in which, it will be observed, there is nothing but addition used :—

Pythagorean Tetrachord.	Logarithm.	Ptolemy's Tetrachord.	Logarithm.
MAJOR TONE ...	0.05115	MAJOR TONE ...	0.05115
MAJOR TONE ...	0.05115	MINOR TONE ...	0.04576
LIMMA	0.02264	MAJOR SEMITONE	0.02803
FOURTH	0.12494	FOURTH	0.12494

This excellent mode of calculating intervals was introduced long ago by French and German writers, and extended examples of its use will be found in Dr. Pole's admirable *Diagrams of the Musical Scale*, which are incorporated with the Rev. Sir F. A. Gore Ouseley's *Treatise on Harmony*. The system has not been followed here ; first, from the wish to bring the explanations within the reach of those who may not understand logarithms ;[a] and, secondly, because

[a] For those who are extra-curious in their calculations, there is a table of acoustic logarithms, calculated, by M. Delezenne, from 1 to 1200 semi-vibrations, expressed in commas. This table is appended to the already quoted *Calcul Musical*, by M. Charles Meerens, in pamphlet form. 8vo. 1864.

the division of a string into its aliquot parts is of practical application, and, to many minds, it will convey a more lively impression of a sound, than will a short row of figures.

And now, quitting the subject of calculations, I turn to another of Nature's musical arrangements. The Pythagorean doctrine of the existence of certain vibrating sounds, some of which are too high and others too low to reach the human ear, has received unexpected confirmation both during the last and in the present century. The existence of sounds that are too high for our hearing has been demonstrated by the discovery that, under certain conditions, the union of two generates a third and much lower sound, which is quite distinct from its two primaries. Next, that this resultant sound may be obtained even when the two primaries are inaudible. On the one side, these *resultant tones* are said to have been discovered in 1745 by a German musician and able writer on music, named Sorge, but that the disclosure attracted very little attention at the time. Then, that they were discovered independently by Tartini, the celebrated fiddle player, in 1754, and, after him, were called Tartini's tones. On the other side, they are said to have been discovered by Tartini while studying the violin in 1714, and that he had taught them to his pupils long before he published his theory of them in 1754.

In an *Analysis of Musical Sounds, with Illustrative Figures of the Ratios of Vibrations*, by John Henry Griesbach, these tones are thus defined : "Resultant sounds are not audibly produced by the combined sounds of a pianoforte, because the sound of a pianoforte gradually diminishes from the instant of its

production to its extinction. For the audible production of resultant sounds by musical instruments, it is requisite that the sounds be continuous and equal. They are produced audibly by organ pipes, and by the metal reeds of harmoniums, also by many different intervals when the strings of a violin or tenor are made to vibrate powerfully. Tartini used to tell his pupils that their Thirds could not be in tune unless they heard 'the low note,' meaning the resultant sound. Resultant sounds may occasionally be heard when two sounds are powerfully sustained by female voices. Triangles, metal bars, and bells, not only produce their Harmonics powerfully, but also resultant sounds."—(p. 65.)

To produce such tones audibly it is necessary that the two primaries be sounded rather loudly, as well as continuously, and it is expedient to select two notes of high pitch for the experiment. Some attention may be required at first to single out the feeble resultant tone, but it will be readily accomplished after a little practice. A guidance to the ear in early experiments will be, that the note to be listened for may be predicted.

Harmoniums that have been carefully tuned yield these sounds much more distinctly than those which have not. The best way of hearing them is upon one of Wheatstone's symphoniums, an instrument which is no longer manufactured, it having been superseded by the concertina. The tone is produced by the same metal springs, but, instead of a bellows, they are breathed upon through the half-opened mouth. By breathing into this instrument, and lightly stopping the ears at the same time, the resultant sound is heard quite as distinctly as the

higher two. The tones pass through the mouth to the auditory nerve by the Eustachian tube, therefore inside the drum of the ear. A further advantage of this method is, that, practically, the springs do not yield Harmonics, therefore there is no confusion of sounds. It is the deficiency as to Harmonics that makes the harmonium an unsatisfactory substitute for the organ. The symphonium should be warmed, to diminish condensation of the breath upon cold metal. When a symphonium cannot be obtained, try the harmonium or concertina.

The following are examples of resultant tones:—

If the two primaries be *e* and *g*, which are Nos. 20 and 24 of the Harmonic scale, and at the interval of a *minor Third*, the resultant tone will be C, No. 4, two Octaves and a major Third below the *e*.

If the same *e*, with *c*, the *major Third* below it, or Nos. 20 and 16, be sounded, the result will be the same C, No. 4, as before, but it will now be only two Octaves below *c*.

If we next try g with the same *c* above it, Nos. 12 and 16, making the interval of a *Fourth*, the result will be the same C, No. 4, as in the two former cases, but now it is only a Twelfth below g.

If we transpose the order of *g* and *c*, and take *g* as a *Fifth* above *c*, Nos. 16 and 24, the resultant tone will be C, No. 8, one Octave above the other.

If we try a *major Sixth*, as g and *e*, Nos. 12 and 20, the result will be C, No. 8.

If a *minor Sixth*, as from *e* to *cc* above it, Nos. 20 and 32, the resultant tone will be g, No. 12, the major Sixth below *e*.

It might have been supposed, from five of the above examples, that all would have resulted in the

true key-notes, had not the last experiment disproved it.

Helmholtz changed the name of Resultant Tones to Difference Tones, and his reason was that the resultant note is that which is equal to the difference between the ratios of vibration of the two primaries. That is true enough, but it does not account for their being audible beyond others. Difference tones only add one more degree of discord to each set of vibrations, and the above are all consonant to the upper notes. Therefore I demur to Helmholtz's new theory, and revert to that of Dr. Thomas Young, that these are the reflected sounds of the consonant vibrations, which are also equal to the difference between the two primaries. There is good reason for their superior audibility; but it would be indeed difficult to find a reason for the predominance of the others.

The two notes which constitute the above example of the minor Third *e* and *g*, when referred to the preceding scale, are Nos. 20 and 24, giving 640 and 768 vibrations. The consonance and the difference are both 128, and if we look for 128 vibrations, we find them produced by C, No. 4 of the scale. Therefore C is the resultant tone. Then taking the last of the series, the minor Sixth, from *e* to *cc*, as another test, they are Nos. 20 and 32, with 640 and 1024 vibrations. The consonance and the difference are both 384, and that number indicates g, No. 12, as the resultant. All the other intervals may be similarly proved. I would, however, suggest that the difference between the two *numbers* in the Harmonic scale is a shorter test than that of calculating the difference between *vibrations*.

I can but suppose Helmholtz's new theories to be due to the imperfection of the instrument which he employed for his experiments. Thus, in Dr. Tyndall's words, when treating on these resultant tones, we are told that "the sound incessantly varies between silence and a tone of four times the intensity of either of the interfering ones"—(p. 278). This is given with all the emphasis of italics.

I have tried the experiment with the most delicate instrument for the purpose, tuned perfectly for me, with cotton in my ears to exclude all external influence, and neither by that means, nor by harmoniums, by concertinas, or other, can I discover any intervals of silence. Furthermore, I have appealed to the highly sensitive ears of Macfarren, J. H. Griesbach, and others, but no one can distinguish them. Then surely they are due to the peculiar character of the Siren which Helmholtz employed for the experiment. And, possibly, the Siren is also to be held responsible for the theory of the "fluctuations." It seems hard to account for it upon any other principle.

The Siren is a nondescript instrument, the tones of which are produced by puffs of air through 12, 20, or 30 holes at one time. So there are virtually 12, 20, or 30 instruments sounding at the same time, and some of these are counteracting the effects of others. If two harmonium-reeds, exactly alike, be placed side by side and sounded together, it is all but certain that the combined tones of the two will have less power than those of either, separately. If two tuning forks of the same pitch be sounded at the same instant, near to one another, the sound of both may

be neutralised by the manner of holding one at an angle to the other. This is a well-known experiment, which I have often made, and one that Professor Tyndall has largely illustrated in his lectures. "It is easy to see," says he, "that the forks may so vibrate that the condensations of the one shall coincide with the condensations of the other, and the rarefactions of the one with the rarefactions of the other. If this be the case, the two forks will assist each other. . . . It is, however, also easy to see that the two forks may be so related to each other that one of them shall require a condensation at the place where the other requires a rarefaction; that one fork should urge the air-particles forward, while the other urges them backward. If the opposing forces be equal, particles so solicited will move neither backwards nor forwards, and the aërial rest, which corresponds to silence, is the result. Thus, it is possible, by adding the sound of one fork to that of another, to abolish the sounds of both" —(p. 256).

It is singular that the intervals of silence did not arouse the attention of the great acoustician to the imperfections of the instrument with which he conducted so many experiments.

Resultant tones had been much experimented upon in England before Helmholtz gave birth to his theory, and they led to the discovery, or rediscovery, that sounds might be too acute to affect the human ear.

Sir Charles Wheatstone, LL.D., D.C.L., F.R.S., had two very minute metal tongues made for him, of the kind used for concertinas and harmoniums, but so minute that their exceedingly acute sounds were

inaudible separately, yet when blown together their graver resultant sound was distinctly within hearing.

Our present Professor of Music in the University of Oxford, the Rev. Sir F. A. Gore Ouseley, Bart., had two very minute open pipes constructed, which were equally inaudible when blown separately, but of which the resultant sound, two Octaves below the calculated pitch of the lower pipe, was distinctly heard. A similar experiment was tried with equal success by Mr. J. H. Griesbach, from whose work, already quoted, the above account of these experiments is derived.

Instruments have been invented for testing the limit of the human ear as to the higher notes, and they show considerable variations in different individuals.

In the case of exceedingly low notes, the sound-waves succeed one another too slowly to effect the necessary *continuity* by which the auditory nerve must be excited in order to convey the impression of a musical sound to the brain. If the vibrations are less in number than 16 in a second of time, the ear is conscious only of separate shocks. If they exceed 38,100 in a second, according to the recent calculations of Helmholtz, the consciousness of sound ceases altogether. "The range of the best ear covers about eleven Octaves, but an auditory range limited to 6 or 7 Octaves is not uncommon. The sounds available in music are produced by vibrations comprised between the limits of 40 and 4000 a second. They embrace 7 Octaves. The range of the ear far transcends that of the eye, which hardly exceeds an Octave."[a]

[a] Tyndall's *Lectures on Sound*, p. 84, 2nd edit. 1869.

Experiments upon very low sounds were exhibited by the late D. C. Hewitt, by the late Professor Donaldson of Edinburgh, but on the largest scale by the present Oxford Professor.

Sir F. A. Gore Ouseley strained a wire of 64 feet in length, and regulated the tension so as to produce C, four Octaves below C in the base staff. When plucked aside, the note was inaudible, and even the half-length was only to be heard by a few favoured ears, but the quarter-length of 16 feet, or the lowest C upon a pianoforte, became sensible to all when put into vibration by a bow. The experiments of Professor Donaldson were of the same character, and with the like result.

These recent investigations have been turned to account by, at least, one manufacturer. It became evident that horns of various kinds might be made of such length in the tube, straight or curved, that although no sound would be heard from its entire length, the player might take up Nature's scale at her fourth Octave, and so produce the eight Diatonic notes within that Octave, and sixteen semitones in the Fifth ; whereas, if he could have sounded the whole length, he would have obtained but two notes in the first Octave, and but three in the second. This has demonstrated the possibility of effecting a great enlargement of the powers of instruments of that class, subject to the one great drawback of their cumbrous size.

Thus the doctrine of the Pythagoreans, which was adopted by Cicero, Pliny, Boethius, and generally in the middle ages, has been unexpectedly verified by modern science.

CHAPTER X.

The musical instruments of the ancients.—Difficulties of the subject.—Athenæus's incorrect account about the Hydraulic Organ.—General names.—Magadis.—Sambuca.—Buxus.—Wind instruments. —Syrinx, or Pandean Pipe.—Pandura.—The Double Reed or Hautboy principle.—The Bassoon and Cornet, or Corno Inglese.—The Gingras.—The Bombos.—Roman Hautboy-player.—Second principle: the Single Reed Clarionet.—The Shawm, or Chalumeau.—A Pythian game of Apollo and the Python.—Pythauli.—Chorauli.—The Box for Reeds.—Many mat rials for Pipes, and their names from countries and from special purposes.—Length of Arabian Pipes proverbial.—Egyptian Pipes many notes.—The Bombyx.—Third principle: the Pipe blown at the end.—The old English Flute and the Flageolet.—The Organ Diapason.—The Egyptian Pipe and Greek Monaulos and Kalamaulos. — Fourth principle: the present Flute. — The Photinx and Plagiaulos. — Egyptian Flute.—Phrygian and Berecynthian Pipes with horns at the end.—Elymos.—Scytalia.—Competitions of Pipers.—The muzzles round their mouths.—Bagpipe.—Fifth principle: the free Reed or Harmonium principle derived from China.—Sixth principle: Trumpets and Horns—Egyptian, Assyrian, Greek, Etruscan, and Roman.

The musical instruments of the ancients have always been found a difficult subject to treat upon; and for several reasons. The first is, because only a limited number of the instruments named by classical authors can be thoroughly identified. This is partly owing to the absence of cotemporary representations in sculpture or in paintings; and even when such are to be found, too much poetical license has not infrequently been taken with their forms, and they are rarely accompanied by distinctive names. Such allusions to them as are to be found in the texts

are generally casual and brief, and often very indefinite. In these cases, other notices have to be sought for, sometimes far and wide; they are then to be collected together, and to be compared.

When all this has been done, the descriptions have often an appearance of being contradictory, and the next step must be to endeavour to trace the source of this seeming contradiction. Sometimes it will be found that a name has been varied on account of a slight, and, perhaps, unimportant difference of pattern, or in the material of which the instrument was made. It is next to impossible to distinguish such differences in sculpture, and hardly less so in paintings, without a previous minute knowledge of what is to be sought for. Again, the same material may have supplied names to widely differing instruments; and, lastly, some even of the ancients, who undertook to describe them, were not musically qualified for the task.

This was especially the case with Athenæus, to whom we are, nevertheless, more indebted than to any other writer, for having collected together a large number of extracts concerning musical instruments. Athenæus had little or no knowledge of their construction, although he seems to have taken particular pleasure in hearing music. If there were no other description extant of the Hydraulikon, or Hydraulic Organ, than the one he has given, it would now be classed among mythical instruments. Fortunately there exist two other good and even minute descriptions. According to Athenæus, the Hydraulic Organ was inflated with water, and the pipes were turned down into the water. Then the water was strenuously agitated

by a youth, and thus the pipes were made to emit an agreeable sound.[a]

This is just such a description as might have been given by any careless observer, who knew nothing of hydraulics or pneumatics, and who did not trouble himself to enquire into the principle of the instrument. Any one who has once heard the rush of water through a pipe into a cistern, after the turncock has turned on the water-supply to a house, will be able to judge whether a series of such pipes would emit "agreeable" sounds. It is not too much to say that no really musical instrument was ever constructed upon such a principle, although the attempt has certainly been made in consequence of Athenæus's description. The true Hydraulic Organ will here be shown to have been of a very different character.

Again, the reader must not expect help, as to music, from the generality of old Latin translations, such as that of Julius Pollux's *Onomastikon*. Many musical instruments are enumerated in the Greek text, but the author of the Latin version knew so little about Greek poetry and Greek music that he could not distinguish between a Mode and a Nome,[b] *i.e.*, between a scale and a hymn. It is, therefore, hardly a matter for surprise that he supposed flutes to have been played upon by strings, instead of by wind.[c] Translations of the same

[a] *Deipno-sophists*, lib. iv. cap. 75.

[b] See lib. iv. cap. 9, 66.

[c] He translates thus: "Plato vero tibiam etiam *multis chordis prœditam* nominavit." — (*Onomastikon*, lib. iv. cap. 9.)—The words in italics were intended as a translation of *πολυχορδότατον*. If he had but considered that χορδή has a second meaning, of "a sound," as well as "a string," as in the perpetually recurring word, "tetrachord," he would, perhaps, have altered his translation to "multisonantem," or "multis sonis præditam."

description are by no means so uncommon as many would gladly suppose, but one such instance will suffice for present purpose.

General names create one of the greatest difficulties to the enquirer into ancient musical instruments; and his first thought should be: "Is this a generic or a particular name?" In the case of the Magadis, or Octave-playing instrument, many seemingly conflicting descriptions are collected by Athenæus. All are reconcilable the moment it is understood that the name "Magadis" was transferable to any stringed or wind instrument that might be played in Octaves. The name was originally given to a foreign instrument. It was a Lydian Magadis upon which Anacreon played, that had twenty strings.[a]

Again, the Sambuca, in Greek, *Sambukē*, is described by one as a small triangular harp with four strings, and of such high sounds as to make it practically of little use. That kind of Sambuca was a small Trigōn. By a second, it is identified with the Barbitos, or many-stringed Lyre. By a third writer, it is made a synonyme for the Lyro-phœnix, or Phœnician Lyre.[b] In a fourth case, it is the large Greek Lyre. In a fifth case, it is a Magadis.[c] In the middle ages, it was at one time a Dulcimer, and at others a large Pipe. In a seventh case, it was a Roman military engine, of a light and portable character, for scaling walls.[d]

[a] "*Ψάλλω δ' εἴκοσι Λυδίην*
Χορδαῖσιν μάγαδιν ἔχων,
Ὦ Λεύκασπι. . . . ."—
(Athenæus, lib. xiv. cap. 37, p. 634, c. and Bergk's Anacreon, frag. 5.)

[b] *Φοῖνιξ* has sometimes the meaning of palm-wood, but not in this case.

[c] See Euphorion, quoted by Athenæus, lib. xiv. cap. 36.

[d] See index to Athenæus, and Liddell and Scott's Lexicon.

It is scarcely to be doubted that the clue to all these varieties is the word "Elderwood." The musical instrument was not originally Greek, which will account for the root of the word not being Greek; but the Romans inherited the name as that of the elder tree, in the form of Sambucus and of Sabucus. Pythagoras and Euphorion speak of the Sambuca as played by the Parthians, and by nations bordering on the Red Sea.[a] Others again attribute it to the Phœnicians. Elderwood, when dried, is very light in point of weight; and first, its portability, and, secondly, its wide grain, would have recommended it for sonority in stringed musical instruments. Again, the facility with which the green pith might be removed from its branches made them useful for large pipes. The system of naming musical instruments after the wood of which they were made was very common in ancient times. For instance: Boxwood, (Gr. *Puxos*, Lat. *Buxus*,) lent its name to smaller pipes and flutes; because, being a hard and close-grained wood, it was suitable for exactitude in the bore of their tubes. It was smooth, and took a good polish, and it would bear rough usage. Clarionets, flutes, and fifes are still made of boxwood. Both in Greek and in Latin the name of this wood is often used for the pipe.

There are so many kinds of general names for musical instruments—some derived from a particular nation—some from an inventor—some from their special use, and some from their shape[b]—that the

[a] Athenæus, lib. xiv., cap. 34.

[b] "Si enim diligentius antiquorum monumenta inspiciamus, tot earum differentias reperiemus quot vel inventores diversi inferre possint, vel regiones ubi vigebat usus, vel sonus, vel materia, numerus, figura, et usus varii postulabant."—(Bartholinus *De Tibiis Veterum*, p. 63.)

more practicable way of treating the subject, at the present time, seems to be according to the principles involved in their construction, and thus in classes, instead of individually. It will greatly abbreviate details, and the various properties of the instruments will be more readily understood.

To which class shall priority be given—to wind, string, or percussion? It may justly be argued that melody first arose between the beats of time that marked rhythm, and therefore rhythm was the parent of vocal melody; but whether instruments of percussion, like the drum, are on that account to be ranked as the first of musical instruments, as Dr. Burney and others would have it, is another question. Upon such a theory precedence must be given to hands and feet before all instruments, but where is their musical sound? The distinction between noise and music is, that the first acts by sudden and irregular shocks, and the second by rapidly succeeding periodic impulses upon the ear. These impulses give the continuity of tone which is called "music." Rather, then, should the play of the wind upon the ends of broken reeds be credited with the first suggestion to man of a musical instrument.

To cut pieces of reed so as to form whistles, was, in all probability, a thought which preceded that of boring holes into one reed, so as to make it emit several sounds. Priority may also be assigned to this practice of blowing at an angle across the ends of the reeds, in the manner of the wind, before that of twisting a string and attaching it to a sounding-board, so as to cause it to produce a musical note. And, thirdly, over the cutting off a part of the horn

of an animal, with the object of employing it as a wind instrument, by inserting the smaller open end into the mouth.

> "Fond zephyrs playing on the hollow reeds
> First taught the rustic how to use his pipe."[a]

The Syrinx of the Greeks is now called Pandean Pipe, or Pan's Pipe, and is rarely seen except with the Punch and Judy showman. It was formed by a combination of short pieces of reed of different lengths, and they were joined together by waxed threads, and tuned to a scale by filling the ends with wax, or by cutting down the reeds exactly to the note.

> "A pipe composed of reeds of lessening height,
> By wax conjoined the greater to the less."[b]

Instruments of that kind are common to uncivilized as well as civilized nations. In consequence of the myth that Pan was the inventor of such pipes, and that he taught the world how to join the reeds together with wax and flax, the Syrinx came to be called the Pandura. This name, instead of Syrinx, was assigned to it only by comparatively late writers, among whom are Cassiodorus, Hesychius, and Isidore of Seville.[c] It has already been shown that the more ancient Pandura, or Pandoura, was a stringed instrument.

[a] "Et zephyri cava per calamorum sibila primum
Agresteis docuere cavas inflare cicutas."
Lucretius, lib. v. lines 1381-1382.

[b] "Fistula cui semper decrescit arundinis ordo
Nam calamus cera jungitur usque minor."
Tibullus, lib. ii. 5, 31.

[c] "Pandorius ab inventore vocatus, de quo Virgilius: Pan primus calamos cera conjungere plures instituit."—(*Origines*, lib. iii. cap. 20.) Isidore derived the quotation from Virgil's Eclogues, ii. 32.

The Syrinx was one of Nebuchadnezzar's musical instruments, according to the Septuagint version of the Book of Daniel, and it was used by the Lydians in going to battle.[a] Nebuchadnezzar's "cornet, flute, harp, sackbut, psaltery, dulcimer," according to the Greek, were the Salpinx, *i.e.*, trumpet, the Syrinx, the Kithara, the Sambuca, the psaltery, and the symphonia, the last being but a vague name for some instrument for harmony.

Theocritus wrote a short poem, under the title of "The Syrinx."[b] It consists of twenty lines, in ten pairs of gradually decreasing length, like the pipes of the instrument. Each of the last pair is composed of a single word of four syllables. From the ten pairs of lines in this poem it may be inferred that, at the time it was written, or in the earlier part of the third century before Christ, the Syrinx had ordinarily ten pipes or reeds. But, according to sculptures of later date, seven or eight reeds was its more usual number.

The Syrinx is of an exceptional character. It is not to be classed with any other, because all other ancient pipes had the wind blown wholly or partially through them; whereas, in the Syrinx, the wind passes in and out of the same aperture. The breath directed against the inner edge of the top of the reed causes it to sound, just as it would upon the inner lip of an empty physic phial.

Setting aside this instrument as one of a peculiar character, there are four distinct principles upon which ancient musical pipes and flutes were constructed, and all were acted upon by blowing

[a] Herodotus apud Athenæum, 627.

[b] Printed by Brunck, in vol. i. of his *Analecta veterum Poetarum Græcorum*. 8vo. n. d.

through at least some part of the pipe, instead of merely across the end of it, as in the Syrinx. Out of these have important modern instruments been evolved, as well as the admirably contrasted tones of organs. All four had their origin in shepherds' pipes, and were made either out of a reed or of a straw. They may still be experimented upon with the original materials, and with the like result.

Shepherds are no longer musical as a class in our latitudes, but boys in country schools exercise themselves occasionally in the craft, and many of them would be good teachers of the four different systems. Having received some instruction, and gained a little practical experience, I will endeavour to explain them. Two are with a vibrating tongue of straw or reed, which is to be held in the mouth, and two are without it.

The FIRST PRINCIPLE is on the Double Reed or Hautboy system.

Take the pulpy end of a straw of green corn, or one of the smallest of reeds without a knot, and split one end by squeezing it. Place the split end between the lips, and blow through the straw. The split part will act like the double reed of the hautboy, of which the ancient English name was Waight. That name was derived from the Castle Waight, or "Watchman," who carried and played upon pipes of this kind at stated hours of the night.

The experimentalist must vary the strength of his blowing till he finds the pitch of this tiny tube, or else it will not sound; and then he can raise or lower the note by shortening the straw or by taking a longer.

The modern bassoon has a double reed on this

same principle, but it is one of larger size than that of the hautboy. Thus it forms the appropriate base to the hautboy.

The intermediate instrument was formerly called the cornet in England, from having been originally made of horn, and still is called the Corno Inglese. It forms the tenor to the hautboy.

And now to trace back instruments constructed on this double reed principle.

In the Egyptian collection at the British Museum is a small reed pipe of eight and three-quarter inches in length, and into the hollow of this little pipe is fitted at one end a split straw of thick Egyptian growth, to form its mouthpiece. When compressed by the lips, this mouthpiece will leave but a tiny space for the admission of the breath. The pipe corresponds so precisely to the descriptions of the Gingras, given by Greek writers, as to leave hardly a doubt of its identity. The agreement is not as to form only, but also as to the wailing tone attributed to the Gingras. That quality could only be produced by a pipe on the double reed principle. The Gingras in the British Museum has four holes for the fingers.

Athenæus,[a] quoting Xenophon, says that the Phœnicians used a kind of pipe, called the Gingras, about a span in length, of very high pitch, and of a mournful tone. Also that it was employed by the Carians in their wailings, and that these pipes were called *Gingroi* by the Phœnicians, from the lamentations for Adonis—"for you Phœnicians call Adonis *Gingres*, as Democlides tells us." So this Adonis-pipe was admittedly of Asiatic origin, and

[a] Lib. iv. 174 f, 175 a.

was most likely common to the various nations of Asia, as well as to Egypt.

Next, the Bombos of the Greeks signified both the base of a scale[a] and a long pipe that produced very low notes.[b] Such a pipe was specially used at funerals; and its name, which signifies "humming" or "buzzing," again suggests the double reed principle. There would be no buzz without a reed, unless a thin piece of skin or parchment were made to vibrate, as paper with a comb, and so to parody the quality of its tone. From a flute of either kind, the tone would be pure, soft, and weak in the base, whether blown from the end or at the side.

For these reasons, it seems a fair inference that the Bombos of the Greeks, and the Bombard of the middle ages, are now most nearly represented by the bassoon. But there is this difference that, whereas the Bombos was a very long pipe, the wooden tube of the bassoon, which would be equally long if straight, is curved back in the middle, or folded in two, in order to avoid the inconvenience of great length. A curved end is therefore necessary to keep the face of the player away from his returned breath. The reed is inserted into the curved end, which is usually made of brass.

Some Etruscan Pipes shew the double reed very clearly.[c] The Etruscans seem to have had a great

[a] Euclid's *Sectio Canonis*, p. 37, edit. Meibom.

[b] "Porro alii sunt bombosi, bombis latissimarum tibiarum non absimiles, quales habere solent ii qui Tumbauli, *i.e.*, Siticines, appellantur."—(Quoted from Galen, lib. iii. *De Sympt. Caus.*, by Bartholinus, in his *De Tibiis Veterum*, p. 278.) "Ideo Aristoteles, lib. iv., *Hist. Anim.*, tradit eos qui calido utuntur spiritu talem emittere vocem, qualem Siticines et Lamentatrices graviorem sonum inspirant tibiis."

[c] See Sir William Hamilton's Collection, vol. ii., plate 41, and vol. iv., plates 81 and 83. (Naples. Fol. 1791-95.)

preference for such pipes. Among their musical instruments are lyres, tabrets or tambourines, with gingling little cymbals attached to them, and the Syrinx. Although the harp is less frequently exhibited, there is at least one specimen to be found on an Etruscan vase in the British Museum.[a]

In the following representation, a Roman holds two conical pipes, which are therefore the true hautboy, as are some of the Etruscan. The original of the picture is in the British Museum, case 67.

Ancient Roman Hautboys.

The SECOND PRINCIPLE is that of the Single Reed or Clarionet system.

Take a straw with a knot at one end and open at the other. To borrow Professor Tyndall's words: "At about an inch from the knot, cut lightly with a penknife to the depth of about a quarter of the straw's diameter. Then, turning the blade flat, pass it upwards towards the knot, and so raise a strip of the straw, nearly an inch long." This strip will be the reed or tongue, to be set in

[a] Amphora, No. 1260, in First Vase Room.

vibration by the breath passing down upon it into the pipe. The straw may be cut the reverse way, that is, beginning from the knot, and with the same effect. The tongue of straw is so pliable as not to require pressure from the lip, as it would in the case of a reed.

Such was the principle of the ordinary pipe of the ancients. The greater depth and volume of tone that could be produced from the middle and lower notes by the employment of a reed, recommended it especially for out-door celebrations.

It was the Shawm, Schalm, Schalmuse, or Chalumeau of a few centuries ago, and it is now represented in an improved form by the clarionet with keys. The clarionet differs from the hautboy in form as well as in the reed, for the clarionet is an equal sized tube, enlarging only at the bell end, but the bell adds nothing to the tone, and might be discarded. The hautboy has been already described as conical.

In all cases where a reed mouthpiece is required, the object most desired by players is to obtain a pliable one. The stiffer the reed the harsher and louder will be the tone produced. There was one case among the ancients in which a stiff reed became rather desirable than otherwise. That was in the Pythian games,[a] when the players had to take part in the representation of the fight between Apollo and the Python. It must have been rather an amusing exhibition for once seeing. It consisted of five parts. First, the attempt; second, the provocation; the third an iambic, and the fourth a spondaic movement; the fifth, the ovation to the god.

[a] When the *νόμος Πύθικος*, or Pythian Nome, was sung.

During the first movement Apollo looked about him to see if the place was convenient for a fight—for even the gods were prudent in such matters. In the second, Apollo provoked the dragon, and in the third they fought. This third movement, being in iambic measure, was excellent for thrusting. (⏑ – | ⏑ – | ⏑ – |.) While the fight was going on, the pipers had both to play, and now and then to imitate upon their pipes the hissings of the dragon, the gnashing of his teeth, and his screams when he was hit by the arrows of the god. (Here the stiff clarionet reed would be most useful.) The base trumpets impressively gave out the dragon's shudders and groans. When the fight was over, came the stately spondaic movement. That was to represent Apollo's victory. Last came the ovation, during the whole of which the god danced to celebrate his triumph. We are not told the measure of this last movement, but, having already had both iambic and spondaic, we may suggest anapæstic, and then we can fancy Apollo carelessly dancing the polka. (⏑⏑ – | ⏑⏑ – | ⏑⏑ – ||.)

For this game the players had especial pipes, called in Greek *Puthauloi*, Latin, *Pythauli*. The same pipes, but not necessarily with the same stiff reeds, were also used with choruses of voices, and thus were called also *Chorauloi*.[a]

The single and double reed principles may be said to have been by far the more general among Greeks and Romans, especially with the latter, who required the loudest pipes for the great dimensions

[a] "Pythaules qui Pythia cantaverat, septem habuit palliatos, qui voce cantaverunt, unde postea appellatus est Choraules."—(Quoted from Hyginus by Bartholinus, *De Tibiis*, p. 81.)

of their amphitheatres. Horace refers to pipes of his time as being bound with copper or bronze, and as emulating the power of the trumpet. He contrasts them with pipes of more ancient days, which were of small bore, slender in size, and had few notes. The ancient pipes, said he, accompanied a chorus, but those of his own time served rather to drown it.[a] This emulation of the power of the trumpet in pipes seems to have suggested the modern name of clarionet; for a clarion was a trumpet an octave above the ordinary one, and clarionet is its diminutive. In this way, the names of instruments are sometimes transferred from one class to another of widely different character.

Whenever we read of an ancient player who had a box,[b] in which he kept the reed or tongue of his pipe, (the *glotta* or *glossa*,)[c] we may infer that he used a double, or possibly, a single reed, because they alone would require the protection. The double reed is the more probable, because a cap over the end of the pipe would suffice to protect the stronger single reed. The necessity exists at this day. The clarionet player has a wooden cap to cover the end of his pipe, but no hautboy or

[a] "Tibia non ut nunc orichalco vincta, tubæque
Æmula, sed tenuis, simplexque, foramine pauco—
Adspirare et adesse choris erat utilis, atque
Nondum spissa nimis complere sedilia flatu."
(*Ars Poetica*, lines 202 to 205.)

[b] Called a *γλωσσοκομεῖον*, or *γλωσσόκομον*.

[c] "Reed," or "tongue," is a more exact translation of *glotta*, or *glossa*, than the usual one of "mouthpiece," which is rather the glottis, into which the reed was inserted. The *glotta* is fully explained by Porphyry in his Commentary on Claudius Ptolemy, where he gives directions for selecting one of close grain, light, and equal, and for moistening the *zugoi* of double pipes before playing.—"*Δεῖ δὲ καὶ τῶν αὐλῶν εἶναι τὰς γλώττας πυκνὰς καὶ λείας καὶ ὁμαλὰς*, &c.—(p. 250, Wallis's edit.)

bassoon player would be without a box, into which he fixes his delicate double reeds when he has ceased to play. The ancient reed-box had a sliding top, like a modern box for dominos. The slide is described in Herōn's explanation of the Hydraulic Organ. The double reed principle is nearest to that of the human voice; but, as the reeds are smaller than the aperture at the top of the throat, their tone has more of the quality that we designate as reedy.

It is next to impossible to identify many of the pipes. The names give no sufficient clue to them. *Aulos* is a general title that does not distinguish between a pipe and a flute; and the Latin *Tibia* is equally indefinite.

Among other materials employed by the ancients, for pipe or flute, were lotus, laurel, palmwood, pinewood, boxwood, beechwood, elderwood, ivory, reeds of various kinds, leg-bones of animals and of large birds, such as the eagle, vulture, and kite; horns of various animals for the bell-ends of certain pipes, and metals of various sorts. Some pipes derived their names from the special purposes to which they were devoted, as Spondauloi, for supplication to the gods; Chorauloi, for accompanying choruses; Chorikoi, for accompanying choral dancings; Dactylic pipes, for a kind of dancing which must have been in common time, from its name, (– ⏑ ⏑); Hippophorboi, for horsekeepers, whose pipes were made of the bark of the laurel; others for travellers, and so on.

Again, pipes were sometimes named after the country or nation from which the Greeks derived them, as Alexandrian, Tuscan, Theban, Scythian,

Phœnician, Lybian, Arabian, which were very long pipes; and Phyrgian, or Berecynthian. The Lybian was a true flute, blown at the side; a Plagiaulos. It was made of lotus, and so was distinct from the horsekeepers' flute which was also attributed to Lybia. The Scythian were of eagles or vultures' legs; and the Theban were made of the thigh-bone of a fawn, and were covered with metal.[a] The length of Arabian pipes was proverbial, and a man, of whose tongue there seemed to be no end, was called an Arabian piper.

The Egyptians had the credit of the many-toned flute,[b] as they had of the many-stringed instruments.

Perhaps another of the ancient pipes may be identified, from its seeming to answer so well to the descriptions; its name, Bombyx, supplies the clue, for the pipe bears some resemblance to "a silk-worm."

Adrian Junius, in his *Nomenclator*, quotes Aristotle to the effect that "these pipes were long, required a great deal of breath, and were blown only with much exertion." If they required exertion, as well as a great deal of breath, they were wide pipes, and were blown through a reed mouth-piece. Pliny, in describing the reeds grown in lake Orchomenus, in Bœotia, says, that one which was pervious throughout was called the piper's reed, (*auleticon*). This reed, says he, used to take nine years to grow, as it was for that period the waters of the lake were continually on the increase. If the flood lasted at the full for a year, the reeds were cut

[a] *Onomastikon*, cap. 10.

[b] The πολύφθογγος αὐλὸς, *Onomastikon*, lib. iv. — "Variosque modos Ægyptia ducit tibia."—Claudian.

for double pipes (*zeugitæ*), and if the waters subsided sooner, the reeds were not so fine, were called Bombyciæ, and were used for single pipes.[a] These reeds threw out shoots around them, and perhaps each row of shoots may have been counted as a year's growth. In Burney's *History of Music*[b] there is a representation of a large musical pipe, copied from "the beautiful sarcophagus in the Campidoglio, or Capitoline Museum, at Rome," and this is, in all probability, a Bombyx. Thereon seem to be the marks of the attributed nine years' growth, from each of which the leaves have been cut away, and they give it the appearance of the silkworm's body, while the five raised circular apertures may have suggested the idea of silkworms' legs. Perhaps, also, the reed was flossy, and thus had a silky appearance.

The Bombyx.

These circular apertures were probably made of horn, and intended as stops by turning them round, and so to close or open the pipe. Such use appears more probable than that they can have been intended either to be plugged, or to be stopped by the fingers during the performance. The pipe is the only large one that I have noticed which can be supposed to bear any resemblance to the silkworm. The Bombyx, says Julius Pollux, was well fitted for orgies, on account of its powerful tones.[c] If it had been played without a reed, the tone of the low notes would have been soft and feeble.

[a] Pliny's *Natural History*, lib. xvi. cap. 66.

[b] Vol. i. plate 6, No. 3.

[c] *Onomastikon*, lib. iv. cap. 10.

The single reeds for mouthpieces, such as we call clarionet reeds, were cut out of Bombyx.

And, now, to the Third and Fourth Principles, which are those of Flutes and Pipes which are blown, either at the end or at the side, without the intervention of an artificial reed to increase the power and to change the quality of the tone.

Of these two, the Plagiaulos, or flute, blown at the side, as at the present time, is the more powerful. The reason is, that the lip is made to serve the purpose of a reed, and it sets the column of air within the pipe into more active vibration. On the other hand, the flute or pipe blown at the end has a stiff mouthpiece, which precludes the use of the lip, and the sounds are weaker, but with nearer approach to perfect purity of tone. The tone is there produced by the breath being directed against a sharp edge.

Instruments of comparatively modern date will sometimes serve to illustrate the principles of ancient ones; and it may, therefore, be noticed that the old English flute, blown at the end, was remarkable for sweetness, but with little power. In France, (according to Rousseau) it had three names —"Flûte-à-bec, Flûte douce, and Flûte d'Angleterre." It has a mouthpiece like the beak of a bird cut short, and the second name exactly describes the kind of tone. Having once possessed a set of four such flutes, of different sizes, I may, with more certainty, speak of the general quality as remarkably sweet and musical, but with little power. The flageolet and the diapason-pipe of an organ are constructed on this same system, and carry out the description.

For exemplification of this third principle, viz.—instruments blown at the end—take a joint of reed which has a knot at one extreme, and is open at the other. Take the knotty end for the mouth, and make a narrow slit through the upper part of the knot, almost to the outside of the reed, so as to admit the breath only through that slit; then cut a sloping notch out of the body of the pipe, about an inch from the knot, so as to leave a sharp edge pointing towards the slit. Against this edge the thin sheet of breath must be directed as it passes through the slit. When blown, the breath will then flutter rapidly against the sharp edge, and that edge will sound the pipe.[a] It would not have any musical sound without it. Such is the principle of the diapason pipes of an organ. The kind of notch to be made may be seen on the outside of the pipes of an ornamental organ-front. This also is the principle of the flageolet. Take off the mouthpiece of a flageolet, and the fine slit through which the breath must pass will be then seen. The inside of the organ pipe has the same long narrow aperture, but is not exposed to the eye. The mouthpiece of the flageolet is added for convenience rather than for use. The pipe may be sounded without it. The two essential parts are the slit and the notch. If a pipe blown at the end has no notch in it, that pipe can only have been intended for a reed.

For exemplification of this principle among the ancients, we may look back to the Egyptian ladies in the plate at p. 63. One of them holds two of

[a] The old English name for this part of the flute was the Fipple. The sharp edge of the notch has also been called the Plectrum, because it is the exciting cause of the sound.

these pipes, with ivory mouthpieces between her lips. The mouthpiece is like that of a flageolet, but the pipes are longer. They seem to be made entirely of reeds, and so would answer to the *Kalamauloi* of the Greeks. The notches in the pipes are not shown in this mural painting, neither are the strings to the lyres in the other portion which forms the frontispiece, but strings and notch were equally indispensable.

The "sweet Monaulos," which, according to Sophocles[a] and others, was derived from Egypt, and the invention of which was attributed to Osiris, was the single pipe of this class. To attribute it to Osiris was about equivalent to saying that it was so very ancient that the Egyptians knew nothing at all about its origin. It had many notes; was a shepherd's pipe; was made of reed; and, on account of the sweetness of its tone, was especially employed at weddings. Athenæus collected notices of this instrument,[b] and, among others, one from Amerias the Macedonian, who calls it the shepherd's pipe, or Tityrinus. This last name was derived from the Tityri, or Satyrs. Again, Athenæus quotes from Alexandrides, "I the Monaulos took, and played a wedding song;" and next, from Protagorides, "He touched every kind of instrument, but drew the sweetest music from the sweet *Monaulos.*"

Whenever we read of a flute or pipe of remarkably soft tone, we may infer that it was one of the two kinds played upon without a reed mouthpiece, and this, blown at the end, would most closely answer to the description. Such pipes had not

[a] See Fragments of Sophocles, No. 227, quoted from his *Thamyris*, by Athenæus.

[b] Lib. iv. cap. 78.

sufficient power for a Roman amphitheatre, but were charming in a room. The tone of all pipes is softest when they have been well moistened by use.

The FOURTH PRINCIPLE is that of our present Flute, blown at the side by the help of the lip, and the breath passing down the tube at a right angle, or nearly so, to the direction of the breath. It is only within about a century that this one kind has monopolized the name of flute. Before that date it was distinguished in France and England as the "German Flute," and in Germany as the "Swiss Flute." It was called Photinx by the Greeks, and the fact of its being turned laterally for playing, gave it the second name of a Plagiaulos. The corresponding name in Latin is *Tibia vasca,* or *Tibia obliqua.* It is found among the earliest monuments of Egypt, and one of great length has been shown in the plate on p. 65, of the fourth dynasty of Egypt. According to Athenæus,[a] the Photinx was made of lotus-wood, and he adds that the lotus grows in Lybia.

Modern flutes are not made of such great lengths as many of the ancient, and consequently they can be held in a horizontal position. If a flute were so long as to reach to the ground, it would fatigue the arm to hold it so high as we do for any lengthened time. Our flutes are held nearly in a balance by the two hands, and in a convenient position for the mouth, through an extension of the headpiece beyond the mouth. This also carries the upper end beyond the face, and so with less risk of being pushed into the eye or mouth of the player. But the principle is not altered. That headpiece is filled

[a] Lib. iv. cap. 80.

by a plug to within about a quarter of an inch of the hole through which the flute is blown. So, the long Egyptian flute, into which the player seems to blow at the very extreme of the side, is the same as our own.[a] He turns the lower end of his flute rather behind him, so that in case of being caught by the foot or leg of a passer, the upper end may be directed beyond his face.

When we see a representation of a man playing a flute of about one foot in length, we may say, at once, "that man is playing the treble," because the length of his pipe will not sound lower than about treble C. If the flute is two feet long, he is playing the tenor part, because such a flute is an Octave below the other. And if four feet long, he is playing the base, because the length of the instrument, roughly taken, gives C in the base staff. So our Egyptian performer with the long flute, on page 65, is certainly playing the base. We could equally tell the compass of the other two pipes which we see to be blown at the ends, if we could determine whether the pipers are, or are not, using single reeds. There are no indications of them, and therefore, in all probability, the music is of the soft English flute kind, like that of the Egyptian lady represented at page 63; but the three instrumentalists are undoubtedly playing music in three parts. The shortest pipe may go down to about *a* in the treble staff, and the longer pipe is about an Octave lower. There is no appreciable object for a selection of pipes of such varied lengths except to play in harmony, and the avoidance of varied sounds would be impossible

[a] This, again, was not understood by Fétis. He supposed the *flûte oblique* and *flûte traversière* to be two different instruments instead of one. So he modestly corrects Athenæus.—(*Histoire*, i. 285.)

when they were used. If the pipes have single reeds, like clarionets, they must still be playing in harmony, but an Octave lower. There is, however, another reason why it is improbable that either of the players with the shorter pipes should be employing clarionet reeds, and it is because, in that case, a flute would make too weak a base for them. On the contrary, such a flute would be quite an appropriate base for the Egyptian Monaulos, which was like the old English flute, or the flageolet.

If the Egyptian pictures have all been copied correctly, and have not been inverted by the engravers, the flute players sometimes held their flutes on the left side of the body, and sometimes on the right. The side-blown flutes were used in the worship of Serapis, and, according to Apuleius, they were held on the right side, as our own.[a] The invention of the Photinx was attributed to Osiris, as well as that of the Monaulos. Each kind was made of various sizes and lengths. Poseidōnius, speaking of a war which the Apamēans were about to wage, says that they had asses laden with wine and every sort of meat, and by the side of them were packed "little Photinges and little Monauloi, instruments of revelry, and not of war.[b]

Dr. Burney doubly mistook the Photinx when he said, on the one hand, that it was the Monaulos, and on the other, that it was a "crooked flute, and its shape that of a bull's horn."[c] He there mixed together three different instruments. Neither the Photinx nor the Monaulos were crooked, neither

[a] "Ibant et dicati magno Serapidi tibicines, qui per obliquum calamum, ad aurem pertractum dexteram, familiarem templi, deique modulum frequentabant." — (Apuleius *Metamorp.*, lib. xi.)

[b] Athenæus, lib. iv. cap. 78.

[c] Burney, vol. i. p. 202.

was either of them shaped at the end like a horn. An instrument made of a bull's horn would have been a Keras, literally "horn;" and a pipe with a horn at the end, or a horn blown at the side, would have been a Keraulos, or horn-pipe. The Monaulos and the Photinx were both straight, and the difference between the two was, that the first was blown at the end, and the second at the side.

Dr. Burney was possibly thinking of the deep-toned Berecynthian pipes which were named from Berecynthus, in Phrygia, and were, therefore, also called Phrygian. Horace refers to these pipes in the first Ode of his fourth Book, and Ovid to the curved horn in *Fasti*, lib. iv. line 181:—

> "Protinus *inflexo* Berecynthia tibia *cornu*
> Flabit." . . . .

Athenæus speaks of the deep-toned Phrygian pipe as having a horn mouth somewhat like a trumpet,[a] and others say, like Ovid, that the ends were turned up with horns.

"The Phrygian pipe," says Porphyry,[b] "is of smaller bore than the Greek, and, therefore, emits much graver sounds." He there assigns a wrong reason. The bell at the end would lengthen the column of air, and thereby give a little deeper tone to Phrygian pipes; but, in all probability, they were like clarionets, blown down into by a single reed, and so had the character of stopped pipes. That would make them an Octave below others. The old theory was, that there can be no difference of pitch between pipes of equal length upon any other principle than that of the one being a stopped pipe, whether

[a] *Deipno-sophists,* lib. iv. cap. 84, p. 185.

[b] *Comment. on Claud. Ptol.,* p. 217, Wallis's edit.

wide or narrow, for width was supposed only to increase loudness. Practically, the variation is very trifling when the length is but 2 or 3 feet; but, when pipes are upon a much larger scale, the increase of diameter sensibly flattens the pitch. If the pipes in question had reeds like clarionets, the expanding mouth would make no difference in the power of tone. In a trumpet, it is the reverse, for all power depends upon the bell. It is difficult to account for a clarionet having the properties of a stopped pipe, but the only Harmonics it produces are two Twelfths, one above the other, and the breath cannot produce a third Harmonic.

Phrygian pipes are described by Aristides Quintilianus as of a feminine character, "for wailing and lamenting."[a] From that it must be inferred that some were on the hautboy and bassoon principle, played with double reeds. So there were Phrygian pipes other than Berecynthian, and it is the more certain, because Aristides contrasts them with the Pythic, which were on the single reed or clarionet principle, and he describes the last as of lower pitch, and having more virility, or power, than the Phrygian. The Phrygian are commonly spoken of as double pipes, and sometimes as equal, and at others as of unequal length. Octaves might be played upon two pipes without doubling the length of one of them, if a low note were taken on the one and a high note on the other.

Double pipes of unequal length were often distinguished as male and female, and their piping as *gamēlion aulēma*, or married piping.

Phrygian pipes were much in request for funerals

[a] "Γοερὸν καὶ θρηνώδη."—(Arist. Quint., p. 101.)

and lamentations. There, again, we have the bassoon principle.

Sophocles refers to a pipe called Elymos, in his *Niobe*, and in his *Tympanistai*, upon which Athenæus comments that "we do not understand it to be anything but the Phrygian, upon which the Alexandrians are very skilful."[a] Again, Juba says that the Elymoi were an invention of the Phrygians, and that they were also called Scytaliæ (σκυταλίας). This name may have arisen from their resemblance to staves, or to Laconian snakes, said to be of equal circumference throughout. J. C. Scaliger says that the Scytalia was a tiny pipe, like a small twig, and of very thin tone.[b] It is to be regretted that he does not give his authority, for a horn could not be fixed at the end of a twig, and his description answers better to the Asiatic Gingras than to the ordinary Phrygian.

Lastly, Julius Pollux says that the Elymos was an invention of the Phrygians, that it was a double pipe, made of boxwood, with a horn end to each tube, and that it was employed in the worship of Cybele.[c] The second pipe may have been then used as a drone. As the two pipes were of boxwood, they would not probably exceed the diameter of a clarionet, nor the length, on account of the weight of the material employed. The definition of Julius Pollux agrees with the former descriptions.

There seems to have been also a stringed instrument called Elymos; for Apollodorus classes it among them in his reply to a letter of Aristocles, where he says, "That which we now call Psaltērion

[a] Athenæus, lib. iv. cap. 79.

[b] "Scytalia vero pusilla fuit tibia, et exigui surculi similis, sono prætenui, ac rei ipso respondente."—(*Poetices*, lib. i.)

[c] *Onomastikon*, lib. iv. cap. 10, 74.

is the same which was formerly called Magadis; but that which used to be called Klepsiambos" (a lyre described as suited for varied metres, and perhaps deriving its name from *kleptō*, to steal, or filch from others,) "and the Trigōn, and the Elymos, and the Enneachordon, or nine-string, have fallen into comparative disuse."[a]

Before parting with the subject of ancient pipes, there are a few points connected with the manner of playing upon them, and with pipers, that should be noted. In the first place, we see representations of men with leathern bands over their mouths, and something of the halter kind over their cheeks and heads. The bands are stretched tightly over the cheek, and a hole is cut in the leather to admit the ends of pipes into the mouth, while the loop over the head seems intended to prevent the strap from slipping below the cheek. This sort of bandaging was called the Phorbeion; in Latin, Capistrum. It served to relieve the lip from the weight of the pipes, but more especially, by its tightness, to diminish the exertion of contracting the muscles of the mouth, which was necessary for the production of high Harmonic notes.

In the competitions between ancient pipe-players, it seems to have been an especial study who should produce the loudest and the highest notes. A competitor would over-exert his lungs, and over-strain the muscles of his face, if he could only obtain Harmonic sounds higher than his fellows. We may smile at their folly in making high notes such an object of competition, but it is not far different from that of the modern tenor singer, who, in his endea-

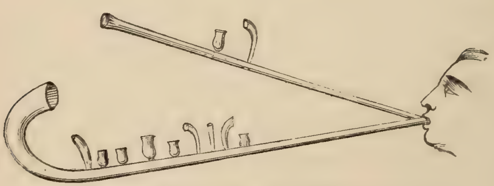
[a] Athenæus, lib. xiv. cap. 40.

vour to bring down the applause of the galleries, will strain his lungs to the very utmost to bring out an "*ut* de poitrine," or high *C*, from his chest voice.

Some of the Harmonic notes from pipes require great exertion, and will even bring a flush into the face and forehead, but not so the fundamental or ordinary notes of the pipes. The following is a player, with a bandage of this kind, copied from the Arch of Titus.


Piper, with a Phorbeion, or Capistrum.

Another peculiarity was that the players had sometimes plugs, or stopples, that passed quite through their pipes. The effect of such plugs might be to shorten the column of air, and so to raise the pitch of the instrument, or, on the other hand, to close the tube so effectually as to make a stopped pipe. The capricious forms of some of them are a puzzle that has hitherto defied explanation, and may continue to do so, until some ancient treatise on pipe-playing shall be discovered.


Peculiar Plugs to Pipes.

The bagpipe had at least the Greek name of Askaulos, but it was very little used by Greeks. The Romans sometimes gave it this Greek name, and, at others, called it the *Tibia utricularis.* It is

to be considered rather as a Roman than as a Greek instrument.

Ancient pipes were of so many kinds, that it has required consideration to place the subject even so far in a digested form before the reader. Other classes of instruments do not present the same amount of difficulty. But, before parting with the subject of vibrating reeds, a Fifth Principle should be mentioned, although we yet lack evidence of any very ancient use.

In instruments of the clarionet kind we have a single reed that extends over, and flaps against, the sides of the mouthpiece. That is called the Beating Reed.

The Fifth Principle is the Free Reed that vibrates without touching any thing. The earliest use we know of it is in Chinese organs, but of these we have no really ancient specimens. Still it is a principle of considerable interest at the present time, because it is the one upon which harmoniums are constructed, and we are indebted to the Chinese for all such instruments. The free reed is now also employed in modern organs. Tongues of this kind will vibrate, and therefore produce musical sounds, whether they be made of wood or of metal. If the tongue be large, so as to fit very closely, and perhaps even to touch the sides of its frame imperceptibly, the tone is more reedy than with a freer space. Hence the varied qualities that may be produced from metal reeds made of the same material. Another variation is caused by superior hardness and closeness of metal.

The Sixth Principle—that of a cup to be blown into by the mouth, using the lip as a reed, as for

TRUMPETS and HORNS, is the same now as ever. It matters not, except for convenience, whether the instruments be curved or straight. They all require the lip to be subjected to strong pressure, the marks of which will often be seen on the player's mouth. It is the lip that makes them sound, by its acting as a vibrating reed. Their great power arises from the bell end.

The ancient trumpet, (*Salpinx* of the Greeks, and *Tuba* of the Romans,) was ordinarily, but not always, straight, and some were very long. Egyptian trumpets seem to have been straight, and, in comparison with others, to have been short. Sir J. Gardner Wilkinson says eighteen inches long. The Assyrian were only rather longer than the Egyptian. The curved trumpet used by Greeks and Romans was of attributed Tyrrhenian, otherwise Etruscan, or Tuscan origin. The tubes were of metal, usually of bronze, and the mouth-pieces of bone.[a] The curvature enabled the Tyrrhenians, who, according to Aristoxenus, were originally Greeks,[b] to have more deeply-sounding trumpets, without inordinate length. Some of the earlier specimens of the straight trumpet, such as one kind of Assyrian, were cones of gradually increasing circumference, in the style of a postman's horn, instead of having only a bell-shaped *kōdōn*, or mouth. Others, like the Egyptian, had the bell end, as in modern trumpets; but the Egyptians had also conical trumpets of four feet in length, without bell ends, and speaking-trumpets of five feet in length, and of large diameter.[c]

[a] *Onomastikon*, lib. iv. cap. 11, and other authorities.

[b] Athenæus, lib. xiv. cap. 31.

[c] Lepsius's *Denkmäler*, Dyn. 4, Abt. 2, Blätter, 27 and 30.

A shell of twisted form was used rather as a horn than as a trumpet, by the Greeks and by the Romans. The Greek name was Kērux, which also signifies a Herald and a Crier, suggesting that it was originally employed by men holding such offices. The Latin name of the shell was Buccinum, and of the trumpet, Buccina. By the Romans it was chiefly, but not exclusively, used for proclaiming the watches of the day and of the night. Virgil, and others, refer to the employment of the Buccina in war, as well as for various other purposes.

When Greece fell under the dominion of the Romans, the ancient Greek name, Kērux, seems to have been dropped, and the Greeks to have adopted an imitation of the Latin, calling it Bukanē.

We may suppose the original to have been the shell with which Tritons are represented on ancient gems.

The following cone-shaped pattern was copied from an antique by Blanchinus, who refers to other such representations.[a] Another Buccina, of curved form, is given by Dr. Burney as "sounded by a Triton on a frieze, in the court of the Santa Croce Palace at Rome."[b]

Burney made the very natural mistake of supposing this conch to have been named *Tromba Marina* by the Italians; but, oddly enough, they gave that designation to a wooden triangular instrument of about six feet in height, with but one string, and played with a bow. In fact, to a Monochord, having nothing whatever of the trumpet, or of the sea about it.

[a] "Figura nostra desumitur ex æenea Tritonis imagine antiqui operis, quam servo. Frequentes occurrunt hæ turbinatæ Tritonum buccinæ in anaglyphis, et picturis veterum," &c.—(p. 16, edit. 1742.)

[b] *History*, vol. i. plate 6, No. 6.

It must not be supposed that the Buccina was always a shell, or even an imitation of one. The name was transferred to any short straight trumpet of metal, with a bell-shaped mouth, and so was opposed to the Salpinx as to size and length, and to the Lituus, as to the latter having a curved end. For instance, Josephus, in describing the two silver trumpets made by Moses, says they were little less than a cubit (21 inches) in length, and scarcely thicker than the reed of a Syrinx; also, that they had bell-ends like common trumpets. To the long common trumpet he gives the name of Salpinx, and to the short and small straight trumpet of Moses, Bukanē.

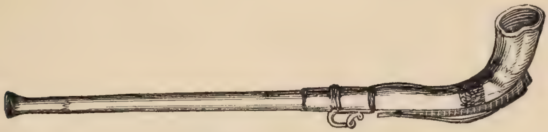
The Kērux, or Buccina.

The Lituus was curved upward at the end, and is said to have taken its name from the bent form of the augural staff. It was a species of clarion, or Octave-trumpet, made of metal, and of shrill sound. The Romans employed it for their cavalry, and the straight trumpet for the foot.

> "Multos castra juvant, et lituo tubæ
> Permixtus sonitus, bellaque matribus
> Detestata."—(Horace, *Ode* i. 1. 23-25.)

The Lituus is usually represented as not exceeding two feet in length, and such were fit for cavalry; but an ancient instrument was found, among other Roman antiquities, in the bed of the river Witham, in Lincolnshire, in 1761, and this had the form of the Lituus, but exceeded four feet in length. The

following is a reduced copy of it, from *Burney's History,* included in plate 4 of vol. i. The instrument was then in the possession of Sir Joseph Banks, and Burney says was of "very thin *brass*, and had been well gilt." As the mixture of copper



A Lituus of large size.

and zinc, to make brass, seems to have been unknown to the ancients, I suspect that for "brass" we should read "bronze."

Horns, straight and twisted, may be so readily imagined that there is nothing more to be said about them than that they were at first, literally, horns of animals, and that these were afterwards imitated in metal. In the first case, they had every variety of Nature's forms, but when made in metal, they were usually curved throughout their entire length, instead of only at the end, as was the Lituus.

CHAPTER XI.

Instruments of Percussion.—The Egyptian Sistrum.—Drum.—Dulcimers. — Timbrels or Tambourines. — Three kinds of Cymbals. — Oxubaphoi. — Lekidoi. — Acetabula. — Krotala. — Krembala or Castanets.

AND now, as to INSTRUMENTS OF PERCUSSION.

Among these, the Sistrum has some claim to be first named, on account of its having been employed in Egyptian temples, and for religious purposes exclusively. It consisted of a thin oval hoop of metal, fixed at the lower end into a handle, and the handle was usually of metal also. The hoop was pierced with holes at equal distances on both sides, and in these holes were three or four loose metal bars, which were all to be shaken at one time, by a light jerk from the hand, and this made them rattle. The bars were like the stems of thin fire-pokers, but they were bent at the ends, to prevent their falling out of their places. "It was so great a privilege," says Sir J. Gardner Wilkinson, "to hold the sacred Sistrum in the temple, that it was given to queens, and to those noble ladies who had the distinguished title of 'women of Amun,' and who were devoted to the service of the deity."[a] The Egyptian Amun was the Jupiter Ammon of the Romans. Again, Sir Gardner says, "The Sistrum was the sacred instrument *par excellence*, and belonged as peculiarly to the service of the temple, as the small tinkling bell

[a] *Popular Account of the Ancient Egyptians*, vol. i. p. 133.

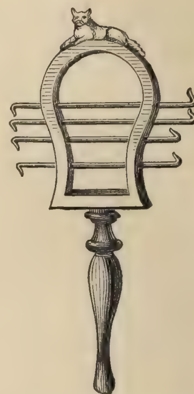
to that of the Roman Catholic chapel. Some pretend it was used to frighten away Typhon," [the Evil Being,] "and the rattling noise of its movable bars was sometimes increased by the addition of several loose rings. It had generally three, rarely four, bars; and the whole instrument was from 8 to 16 or 18 inches in length, entirely of brass or bronze. It was sometimes inlaid with silver, or gilt, or otherwise ornamented; and being held upright, was shaken, the rings moving to and fro upon the bars. These last were frequently made to imitate the sacred asp, or were simply bent at each end to secure them. Plutarch mentions a cat with a human face on the top of the instrument, and at the upper part of the handle, beneath the bars, the face of Isis on the one side, and of Nephtys on the other," [signifying the beginning and the end.]

"The British Museum possesses an excellent specimen of the Sistrum, well preserved, and of the best period of Egyptian art. It is one foot four inches high, and had three movable bars, which have been unfortunately lost. On the upper part are represented the goddess Pasht, or Bubastis," [the Greek Diana,] "the sacred vulture, and other emblems; and on the side below is the figure of a female, holding in each hand one of these instruments.

"The handle is cylindrical, and surmounted by the double face of Athor," [the Venus of Egypt,] "wearing an 'asp-formed crown,' on whose summit appears to have been the cat, now scarcely traced in the remains of its feet."[a]

[a] *Popular Account of the Ancient Egyptians*, vol. i. p. 131.

Dr. Burney exhibits a perfect specimen of a Sistrum with the cat upon it, copied from one in the library of Geneviève at Paris,[a] which is here reproduced.



An Egyptian Sistrum.

The following is a translation of Plutarch's account of the Sistrum, in his treatise on Isis and Osiris. It shows why this instrument of religion was carried only by married women, and the signification of the cat as an emblem. Isis was the supposed enemy to Typhon, and Osiris was the supposed judge of the dead :—

"The Sistrum likewise indicates that it is necessary that beings should be agitated, and never cease to rest from their local motion, but should be excited and shaken when they become drowsy and languid. For they say that Typhon is deterred and repelled by the Sistra ; manifesting by this, that as corruption binds and stops" [the course of things] "so generation again resolves nature, and excites it through motion. But, as the upper part of the Sistrum is convex, so the concavity of it comprehends the four things that are agitated. For the general and corruptible portion of the world is comprehended indeed by the lunar sphere ; but all things are moved and changed in this sphere through the four elements of fire and earth, water and air. And on the summit of the concavity of the Sistrum, they carved a cat, having a human face ; and on the under part, below the rattling rods, they placed on

[a] Burney's *History*, vol. i. plate 5, No. 13.

one side the face of Isis, and on the other that of Nephtys, obscurely signifying by their faces generation and death (or corruption); for these are the mutations and motions of the elements. But by the cat they indicated the moon, on account of the diversity of colours, operation by night, and fecundity of this animal. For it is said that she brings forth one, afterwards two, three, four, and five kittens, and so adds till she has brought forth seven; so that she brings forth twenty-eight in all, which is the number of illuminations of the moon. This, therefore, is perhaps more mythologically asserted. The pupils, however, in the eyes of the cat are seen to become full and to be dilated when the moon is full, and to be diminished and deprived of light during the decrease of this star."[a]

However debased were many of the superstitions of the ancient Egyptians, as to the supposed emblems of their gods, there was some part of their philosophy in which they were in advance of other heathens; and, so far as knowing the true form of the earth, they were in advance of the heads of the Roman Church to within the present century.[b]

The Egyptians worshipped Osiris as the sun, and Isis as the moon; and when Manetho, the Egyptian priest, states their emblems, he adds, "Statues and holy places are prepared for them, but *the true form of God is unknown.* The world had a beginning, and is perishable—*it is in the shape of a*

[a] The translation from a note in Book xi. of Apuleius. Bohn's edit. For the original, see Reiske's edit. of Plutarch, vol. vii. p. 481.

[b] Although various navigators had then sailed round the world, the Roman authorities still maintained that the earth was a plain, and that there were no Antipodes. Moreover, they prohibited the circulation of all books that taught the reverse.

ball. The stars are fire, and earthly things are under their influence. *The moon is eclipsed when it crosses the shadow of the earth.* *The soul endures,* and passes into other bodies. *The rain is caused by a change in the atmosphere.*"[a]

There are many points of resemblance between the Egyptians and Christians which might interest the curious, but they are beyond the scope of the present work. I will only name one which I do not recollect to have seen noticed, and that one, only because it is included in a book to which few would think of referring upon such a subject. It is as to sprinkling with water those who enter the temples, to purify them. Vessels of water were kept at the entrances of Egyptian temples for that special purpose.[b] As to the Sistrum, according to Bruce, the Abyssinian Christians retain it in use in their worship, instead of little bells; and one of triangular form, with rings on its bars, seems to have been used in Italy at the time of child-birth as late as the sixteenth century.[c]

The Assyrians had an instrument with bars of metal such as those of the Sistrum, but, instead of being straight and loose, they were fastened into a long shallow box as a sound-board, and bent to curves of different heights, so that they might with greater ease be struck separately by a rod of metal held in the right hand. This instrument approaches

[a] Manetho's *Compendium of Natural Philosophy* — "τῶν φυσικῶν ἐπιτομή," quoted through Diogenes Laertius, by Bunsen, i. p. 74.

[b] Herōn of Alexandria, *Spiritalia*, No. 31.

[c] "SISTRUM Ovid, crotalum Virgilio. Instrumentum æneum ferreumve trigonum ferme, orbiculis annulisve bacillo ferreo complosis tinnitum edens, ad quos staticulos edebant olim puellæ, qui mos in Italia etiam num durat."—(Adrian Junius's *Nomenclator*, edit. John Higins, p. 350. 8vo. London, 1585.)

more to the class of dulcimer than to any other. Its Assyrian name is unknown, and although a recent writer has proposed for it the Hebrew one of Asor, I prefer that of Assyrian dulcimer, because the Hebrew word "Asor" has no such meaning as "a musical instrument," but is simply the numeral "ten." This will be seen in the sequel, under the Hebrew instruments, where the question is fully discussed.

An Assyrian Dulcimer Player.

The Egyptians had instruments of the same class as the above, but they played them by pulling the wires. In one case the two ends were fixed, and in the other one end of the wire rods was left free. Representations will be found in Sir J. Gardner Wilkinson's *Popular Account*, vol. i. p. 120.

These instruments must have been for the purpose of obtaining Harmonic sounds from vibrating rods, just as now exemplified in lectures on sound. The

Egyptian instruments are curious anticipations of supposed modern discoveries.

The large drums of the Egyptians were shaped like wide barrels, about two feet and a half high and two feet broad, and were beaten at the ends by drum-sticks covered with leather pads. The drum-heads of skin or of leather were ingeniously tightened by strings, as in some modern drums. The Egyptians had likewise small drums, which were in the proportion of three or four degrees of length to one of diameter. These, also, had a wider circumference in the middle than at the extremes, and were hung from the neck to a little below the waist of the player, so as to be conveniently tapped at the ends by the fingers. The modern Hindoos use a drum of this kind. The Egyptians had timbrels or tambourines, both round and quadrilateral; also cymbals of various sizes; and clappers, or short maces, to be sounded by being knocked together.

The quadrilateral tambourines were sometimes divided into two by a bar, so that one end might be tuned to a different note, possibly to a Fifth above the other. They do not seem to have added bells, or tiny cymbals, to tambourines, as did the Greeks, Etruscans, and Romans.

The Greeks had, at least, three kinds of cymbals. First, the Kumbala, which appear to have been the largest, and of metal; next, the Lekidoi,[a] which, judging from their name, were perhaps the oval

[a] For the name *Lekidoi*, see Nicomachus, p. 13, and Iamblichus' *Life of Pythagoras*, cap. 26. For an example of the oval dish, or sauce-boat shaped cymbals, with ring handles, see plate 21 of *Herculaneum*, by Thomas Martyn. London, 1773. 4to. For the round shaped, see Burney's *History*, vol. i. plate 5, No. 7.

dish-cover shaped metal cymbals with handles, of which kind we see so many in the hands of dancing nymphs; and, thirdly, the Oxubapha, or Oxubaphoi. The last were named after the Greek vinegar saucers, and were therefore of diminutive size. They were perhaps such as were suspended in the frames of their timbrels or tambourines. The Romans had large cymbals like the Greeks, and used them specially for festivals. They had also the same small metal cymbals, which they named, from their silver vinegar cups, Acetabula.

According to Clemens Alexandrinus, cymbals were the war-instruments of the Arabs. "Cymbals," says St. Augustine, "are compared by some to our lips, because they sound by touching one another."[a]

The short Egyptian maces, for clappers, were called by the Greeks Krotala, and were especially used in the imported worship of the mother goddess, Cybele. The Krotala were either hinged, or had a weak spring, midway between the two heads or knockers, so that they could be bent towards one another. They flew apart by the opening of the hand, and clapped together when it was shut. Sometimes the Krotala were made wholly of wood, or of a split reed, with something to clash at the two ends.

These latter forms are found among the Romans, under the Latinized Greek name, Crotala. Publius Syrus, in his *Sententiæ*, calls the stork *crotalistria*, on account of the noise made by the bird in striking together the two bones of its beak.

All nations have had castanets of some kind. Their origin has been debated between nut shells on the one hand, and cockle or oyster shells on the

[a] *Comment. on Psalm*, No. 130.

other. Climate and the character of the country had more to do with the use of either than any thought of invention. The Greek name for the castanets used to accompany dancing was *Krembala.* "And beating down the limpets from the rocks, they made a noise like castanets."—(κρεμβαλίζουσι.)[a] They were sometimes made of metal, and gilt.

The principle of ancient instruments of percussion has been so entirely the same in all ages, and in all districts, that there is scarcely a difference between them worthy of note. They marked rhythm, but had little else to do, either with the art or with the science of music, and the only thing now required is to be able to recognise them under their various names.

[a] Hermippus, apud Athenæum, lib. xiv. cap. 39.

CHAPTER XII.

Stringed instruments.—The four grades of Lyre.—Phorminx, Kithara, and Chelys.—Polyphthongos, Polychordos, Barbitos, or Asiatic Lyre.—Sambuca, or small Trigōn.—Etruscan Lyre. —The fabulous Tripod of Pythagoras.—Apollo an ill-used god. —The Pēktis.—Nabla.—Pandoura.—Skindapsos.—Pēlēx.— Greeks no originators of new principles in instruments.— Appendages of the Lyre.—Psaltery a class of Harp.—Large Trigōn.—Psalmos.—No wire strings.—Epigoneion and Simikion real Harps.—Egyptian Harps of various kinds.—Etruscan imagination.—Bands of blind men.—Roman use of four strings. —Boethius an indifferent authority upon music.

Of stringed instruments much has already been said incidentally. As to the different sizes, and different kinds of Lyre, Aristides Quintilianus classifies them in the following manner:—First, the parent Lyre, as the most masculine, on account of its low and rough tones. This was therefore the largest kind of Lyre, and probably was often on a stand, as its name agrees with that of a fixed star. Next to it, the Kithara, as a little less low and rough, but not differing materially from the Lyre. The Kithara was a portable instrument, and as the quality of yielding low sounds must depend mainly upon length of string, it may be ranked as rather less in size than the Lyre proper. It is now indistinguishable from the Phorminx, which was also portable; but a third kind, the Chelys, derives its name from its having had a shell back. Aristides passes on from the Kithara to the Polyphthongos, "or many-sounding"

Lyre. This is elsewhere termed the Polychordon, or "many-stringed," and is equivalent to the Barbitos,[a] or Asiatic Lyre. Anacreon preferred instruments of many strings, and he refers to the Barbitos, as of the lyre kind. We know that Greek lyres had not attained to many strings in his time. Horace likewise alludes to the Barbitos as a Lesbian instrument, and devotes it to the hands of Polyhymnia.—(Ode i.)

"If neither Euterpe withhold her double pipe, nor Polyhymnia flee away to strain the Lesbian Barbiton."

Theocritus describes the Barbiton as many-stringed,[b] and Euripides again makes it a synonyme for lyre. Aristides describes the Polyphthongos as of a feminine character, in contrast to the larger Lyre and to the Kithara, as masculine. It is hardly to be doubted that the instrument which is seen in the hands of the young girl at p. 118, where she is reading music from a scroll or book, is the Polyphthongos or Barbitos. The description as "feminine" means that it yielded higher sounds than the larger instruments, which had also fewer strings.

The following representation of Terpsichore, with a lyre, is from Herculaneum.[c] As the eruption of Mount Vesuvius, by which both Herculaneum and Pompeii were overwhelmed, took place in the year 79, the representation cannot be of later date than the first century of the Christian era. The lyre is of the more poetical kind—fit for recitation, but of very little use for music, in our sense of the word.

[a] Also called Barbiton, Barumiton, and Barmos.—(Athenæus, iii. 1014, 1016, and Julius Pollux's *Onomastikon*, lib. iv.) Euphorion speaks of the Barōmos and Barbitos separately.—(Athenæus, lib. iv. cap. 80.) See also Strabo, lib. x.

[b] *Idyll* xvi. line 45.

[c] *Antichità di Ercolano*, vol. ii. p. 31. Naples, 1757-59. Fol.

Terpsichore, with a Lyre.

The wood of the crumbling Greek Lyre in the British Museum is sycamore; and it is noteworthy that the Egyptian Lyre in the Berlin Museum, and the two in the British Museum, are of the same wood.

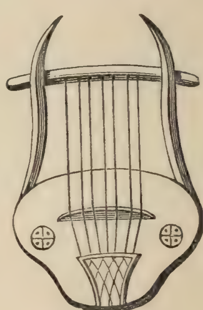
The most feminine, or highest sounding of lyres, according to Aristides, was the Sambuca.[a]

[a] Arist. Quint., p. 101.

Strabo says that this name is "barbarian;" the Phœnicians, the Parthians, the Scythians, and the Trōglodytes or cave-dwellers, have in turn had the credit of the invention. The last were a wise people to have made their homes under ground, when they had such a country to inhabit as the borders of the Red Sea. The Parthian and the Trōglodyte instruments are said to have had but four strings.[a] We may suppose this kind to have been the little Trigōn.

Aristides does not name the Phoinix nor the Atropos, but they must have had many strings, for Aristotle refers to them as magadizing, or octave-playing, instruments.[b] According to Sēmos of Delos, the ribs of the Phoinix were made of the palm tree.[c]

Among the Etruscan antiquities in Sir William Hamilton's collection,[d] is the accompanying representation of a small lyre of peculiar construction. It has a tail-piece for the attachment of the strings; a bridge to raise them; and sound-holes for the escape of the tone. The strings are seven in number, but virtually only four, because, while the base string is but single, the others are doubled. Six are placed closer together, in twos, so that the plectrum could sweep from one to another. I find nothing like it among Greek instruments, but the bridge, the tail-piece, and the sound-holes, are ancient Egyptian. We find



Etruscan Lyre.

[a] Athenæus, lib. xiv. cap. 34.

[b] Prob. xiv. of Sect. 19.

[c] Athenæus, lib. xiv. cap. 40.

[d] Etruscan Antiquities, vol. i. p. 109. Naples, 1666-67. Fol.

a bridge to the hieroglyphic lute on p. 62, and sound-holes to one of those in the frontispiece, and again at p. 43.

Athenæus quotes a story told by Artemōn,[a] that Pythagoras once strung the three sides of a Delphian tripod, such as was used to support an ornamental vase, and that he tuned one side to the Dorian scale, another to the Phrygian, and the third to the Lydian scale or mode. So far, all was possible; but it is improbable that Pythagoras should have attempted it, because there could be no tone from such a tripod, for it had no sounding-board. The minuteness of the remaining part of the story proves the whole to be a myth. Artemōn adds that Pythagoras contrived a pedal to turn this tripod, and that he twisted it about with such rapidity while he was playing, that any one might have fancied he was hearing three players upon three different instruments.

Pythagoras, at least, had ears; and no one possessed of them could have tolerated such barbarisms as rapid changes from D minor into E minor, and then into F sharp minor, and back again. Artemōn admits that it is uncertain whether such an instrument ever existed, and there can be no doubt the story was fabricated by some one who had no knowledge of music. That, indeed, would not preclude a painter from depicting such a tripod, and so the curious may see the imaginary instrument copied into Dr. Burney's *History of Music.*—(Vol. i. plate 5, No. 11.)

Another instrument, which demands a certain amount of faith to believe in it, is depicted upon an ancient vase in the Munich collection, No. 805. It

[a] Athenæus, lib. xiv. cap. 41.

is supposed to be in the hands of Erato, and it is perhaps as mythical as the Muse. No sounding-board is shown, and, without one, it could have no tone. The form does not even seem to admit of such an addition.

There are many more ancient instruments for which we are indebted to the invention of painters and of sculptors. Some are made so heavy with ornament that any tone produced by the strings would have been inaudible at the distance of a few yards. Others are without sounding-boards. Apollo was in these respects a particularly unfortunate god. He had scarcely ever a lyre that would have been worth an obolus for its music.

Erato's Harp on an Etruscan Vase.

The Pēktis is almost as perplexing as the Sambuca. Sōpater says that it had two strings.[a] In that case, it must have had a neck and a finger-board, like the hieroglyphic lute. But then Diogenes, the tragic poet, says that it was harp-shaped.[b] That was quite another instrument, and one that had neither neck nor finger-board. Plato supports the second description, by referring to it as a Trigōn, or harp, having many strings.[c] Again, both Aristoxenus and Menæchmos identify the Pēktis as a kind of Magadis,

[a] Athenæus, lib. iv. cap. 81.

[b] Athenæus, lib. xiv. cap. 38.

[c] Plato, *Republic*, lib. iii. cap. 10.

and the former adds that it was played with both hands, without the use of a plectrum.[a] In those cases it was an Egyptian harp. Anacreon and Sophocles ascribe this instrument to the Lydians. The root of the name has seemingly to be sought in some language other than Greek. The description of Sōpater is irreconcilable with those of others; and, further, there were also lyres and pipes called by the same name.[b]

Again, as to the Greek Nabla, Euphorion distinguishes between the Nabla and the Pandoura. This is, perhaps, only as to name, for, in the same sentence, he joins together the Barōmos and the Barbitos,[c] which two instruments, quotations from other authors seem to identify. Sōpater appears to attribute the Nabla to the Phœnicians, when he alludes to the sounds produced by the hand upon the neck, (*the laryngophōnos,*) of the Sidonian Nabla. Yet, Mustakos, in *The Slave*, notices the emblem of the lotus painted upon the ribs of the instrument.[d] The lotus was the emblem of Lower Egypt, and the Phœnicians were the corn carriers of Egypt. An instrument with ribs had, in all probability, a back rounded like a lute, for that form alone would require to be ribbed. It is probable, then, that the Nabla is one of the two kinds of lute exhibited in Egyptian paintings, as in the frontispiece to this book; and, possibly, Pandoura may be the Greek name for the other.

And now, while on the subject of the ribs of an instrument, which ribs would only be made for one rounded at the back, there is an antique pantheistic

[a] Athenæus, lib. xiv. cap. 36.
[b] See Liddell and Scott's *Lexicon*.
[c] Athenæus, lib. iv. cap. 80.
[d] Athenæus, lib. iv. cap. 77.

gem of the second century, which exhibits both the ribbed back and the receding head of the lute. It represents, perhaps, Osiris as Apollo, with the seven rays, for the rising sun. On the head are the wings of Hermes; under the chin, the moon; and at the back of the head of Apollo, the trident of Neptune, and a lute, instead of the lyre, for Hermes. The gem is cut in chalcedony, and is here copied from the collection of *Gemme Antiche*, by

Causeus de la Chausse, Rome. 4to. 1700. This is the earliest that I have yet observed with the receding head, which distinguishes the lute.

With all the care that can be taken, and after every word of the description has been studied, ancient musical instruments are a difficult subject, and one of which but little can be gleaned. What can be said of the Skindapsos? We know only that it was a "barbarian" instrument, and that it had four strings. Again, the Spadix, one of the same class, having high notes. The Pēlēx was a kind of psaltery, according to Julius Pollux, and the only guide to its probable form is that the name also signifies a helmet.

Perhaps no one thing is more likely to strike the reader in the foregoing account than the very limited amount of invention among the Greeks, if there was even any at all, as to musical instruments. These seem to be all Asiatic or African. Even the word

"lyre" has not been traced to a Greek root, and we have representations of many-stringed lyres in Egyptian paintings before the Greeks were a nation. Again, the Dorian Mode was the one upon which the Greeks prided themselves; and Herodotus, in tracing the genealogy of the Dorians, makes them natives of Egypt; adding that, in this respect, the Lacedæmonians resemble the Egyptians—their heralds, musicians, and cooks, succeed to their fathers' professions, so that a musician is the son of a musician.[a] We can find no new principle for stringed instruments discovered by a Greek, nor anything new in pipes. All was ready-made for them, together with their system of music. The Greeks were even inapt pupils; for, although they had many strings ever before their eyes, they did but reduce the number, after a time, to bring the instruments down to their own level. They practised a certain amount of harmony, but not so much as earlier nations. Cultivation of the ear is required to be able to appreciate many different notes running together at one time, especially with different qualities of tone. We read of no such combinations of instruments in Greece as we see with our own eyes in Egypt; and Greek definitions of concord and of discord are almost invariably limited to two simultaneous sounds. On a first perusal of Greek authors on music, I had formed a much higher estimate of the nation in comparison with others, than a subsequent more general acquaintance will sustain.

If the following account of the present state of music in Japan, as given by a recent visitor, may be relied on, the Japanese are now very much in the

[a] Herodotus, Erato, vi., 53 and 60.

condition of the earliest Egyptians and Greeks as to music, and they, too, must have had a Hermes, or an Apollo, among them :—

"The music of the Japanese is worth extremely little. To accompany the singers on the stage, they have an orchestra of twenty-one performers. The 'Syamsia' is the principal instrument. It is a kind of guitar with three strings, two being toned in the Octave, and the third in the dominant. The body of the instrument consists of the shell of a turtle, in the cavity of which the sounds produced by the three strings are re-echoed, the strings being set in movement by a small rod, made of horn. From this wretched instrument, the reader may form an idea what the others must be. The Japanese are not acquainted with harmony, and their instruments are played either *unisono*, or in the Octave. As regards intervals and rhythm, the poverty of their melody is such that no European musician can possibly conceive it. The Japanese, nevertheless, listen with pleasure to their music for hours together. Blind people are exceedingly numerous in Japan, even if we leave out of consideration the beggars who feign blindness. The bands which play at festivities and private parties are composed of blind men."[a]

Here we have actually the lyre of the Egyptian Hermes, with the two outer strings sounding an Octave apart, and the middle string a Fifth from the lower, and a Fourth from the upper. We have also the shell back to the instrument, and a piece of horn for the plectrum. Thus, wherever music is in its infancy, we may encounter the same kind of story again and again.

[a] *Musical World*, Nov. 28, 1868, p. 817.

Before passing on to the many-stringed instruments, such as harp and psaltery, something may be said about the appendages to the lyre.

The magas, or bridge, which was added to some kinds of lyre, and which is shown on the Etruscan lyre at p. 298, was admittedly of "barbarian" origin. Hypolyrios has been also occasionally translated "bridge," but its more precise meaning seems to be the cross-reed,[a] or fixed cross-bar, to which the lower ends of the strings were attached in very early lyres, and not the movable bridge over which strings were passed in order to raise them above the body of the instrument. In many cases there was no sounding-board which could be in the way of a hand on the strings, and so that which is strictly a bridge was not necessary.

According to the Latin version of Julius Pollux, but not at all according to the Greek, the Hypolyrios formed the *sides* of the lyre.[b] The translator was led into that misconception by adhering to the old

[a] "Προσεπιτέρπεται δ' ὁ φορμικτὰς Ἀπόλλων,
Ἕνεκα δόνακος, ὃν ὑπολύριον
Ἔνυδρον ἐν λίμναις τρέφω."—(Aristoph. *Ranæ*, 231-233.)

[b] This translation of ὑπολύριος has passed uncorrected by the numerous commentators upon Julius Pollux, who have made notes upon the passage. The Greek is, "Καὶ δόνακα δέ τινα ὑπολύριον οἱ κωμικοὶ ὠνόμαζον, ὡς πάλαι ἀντὶ κεράτων ὑποτιθέμενον ταῖς λύραις. Ὅθεν καὶ Σοφοκλῆς εἴρηκεν, Ὑφῃρέθη σου κάλαμος, ὡσπερεὶ λύρας."—(Lib. iv. cap. 9, 62.) The Latin translation given is, "Et arundinem quandam comici Hypolyrium nominarunt, quod olim lyris, *cornuum loco* apposita sit : unde et Sophocles dixit, Sublatus tibi est calamus qui *circa lyram* fuit." So, although a ὑπολύριον and ὑποτιθέμενον, it has been supposed to be neither at the bottom nor at the top, but at the *sides* of a lyre; and the ὡσπερεί of Sophocles has been mis-translated to suit this interpretation, as if he had written ὡσ περί. This is through having translated ἀντὶ κεράτων by *cornuum loco*, instead of *cum cornibus;* and it has led into the very evident misconception, that a stiff and brittle reed could be so twisted as to take the place of two horns on opposite sides of a lyre.

manner of rendering the preposition *anti* by *loco,* although, just as in a case before cited, (p. 53, note *b*,) it was in evident contradiction to the sense of the whole passage.

The Greek lyre seems to have been tuned at the lower end of the strings,[a] and that part of the instrument to have had the name of the Chordotonon, or Batera.[b] The Echeion was the sounding-board, or rather the sounding part of the body.

The lower parts of the curved sides of the lyre were called Angkōnes, and above them were the Pēchees, or fore-arms, also called Ktenia, for which Kerata, horns, were sometimes substituted. The Zugon, (in Latin, Transtillum,) was the cross-bar that yoked together the fore-arms, or horns, and along which the upper ends of the strings were either tied, or otherwise fastened. In some Egyptian lyres this cross-bar sloped, and the strings were tuned by sliding the noose upwards, and so increasing the tension.

An eighteen-stringed Egyptian lyre will be found preceding the pipes and harp, in the following from Wilkinson's *Egypt.*

Singers, accompanied by Harp, Double Pipes, and Lyre.

[a] "Ὑπερθεὶς ἑκάστῃ πῆχυν, καὶ κάτω προσαρμόσας χορδοτόνια." —(Athenæus, lib. xiv. cap. 41.)

[b] Pythagoras, in his experiments, is said at length to have transferred the strings "εἰς τὸν τοῦ ὀργάνου βατῆρα, ὃν χορδότονον ὠνόμαζε."—(Nicomachus, p. 13, lines 8, 9; and Iamblichus' *Life of Pythagoras*, cap. 26.)

Psaltery was a general name for several kinds of stringed instruments. The Greek word, *psaltērion*, is derived from *psallein*, to twang a string with the fingers, as a bow-string. Every stringed instrument which was played upon with the fingers of both hands, instead of by one hand and a plectrum held in the other, came under the denomination of a psaltery. Therefore the Greek name for a harp was also *psaltērion*. Again, the harp might be called a Trigōn, in reference to one of triangular shape. Aristotle combines the two words, Psaltērion and Trigōn, in defining our harp.[a] On the other hand, Psalteries were not necessarily Trigōns, as will be seen from the following copy of a painting found in Herculaneum.[b]

The instrument is evidently the four-sided, or "Upright Psaltery," (Ψαλτηρίον ὄρθιον). A second representation of one of the same description is also included in the Herculaneum collection. It has a similar outline, and the same number of strings; but the painter, who placed it in the hands of Achilles, and represented him as taking his music-lesson from the Centaur Chiron, forgot, in that case, that there was such a thing as a sounding-board necessary to give sonority to the strings. However, to give the artist the benefit of the doubt, he may have intended to represent Achilles as taking his music-lessons upon a dumb instrument, in order that he might not offend Chiron's ears.[c]

In the following representation the Muse Erato holds a ten-stringed psaltery; and, happily, both

[a] "Ἔτι οἱ ἐν τοῖς τριγώνοις Ψαλτηρίοις . . . συμφωνοῦσι διὰ πασῶν."—(Prob. No. xxiii. of Sect. 19.)

[b] *Antichità di Ercolano*, vol. ii., p. 41, Napoli. 1757-59. f.

[c] Dr. Burney has included a copy of this Psaltery without sounding board, in his *History*, vol. i. plate v., No. 12.

the name of the Muse, and that of the instrument which she holds, are given at the foot, so as to remove any doubt.

Erato, with an upright Psaltery.

Athenæus' distinction of an "upright" psaltery might lead to the inference that there was another kind to be used in a horizontal position. In such a

case the employment of wire strings might be suspected, and that, so far, it would resemble the modern dulcimer ; but no sign of the employment of such thin wire strings as would be required for this purpose has yet been traced among the ancients; or, at least, no such discovery has hitherto been made known. We have no proof that the art of wire-drawing was then understood, and Athenæus must therefore be supposed to distinguish between the quadrilateral and the triangular psalteries.

In the Egyptian Sistrum there were loose bars of metal to be rattled by shaking ; and in the Assyrian dulcimer there were firm bars of metal of different lengths, fixed into a frame by bending, and these were to be struck by a short rod ; but in no case have such thin wires yet been found as could be tuned by turning them round a pin or a peg.

The Egyptian instruments made of metal rods, and fixed either at one or at both ends, have already been referred to.

The psalteries of ancient Greece cannot have been strung with wire, because no such instruments would have been played upon with the hands. The ancient Greeks were very tender of their fingers, as may be seen by their preference for a plectrum to touch even the finer catgut strings of the lyre. Fingers were their purveyors for the mouth, and the forefinger of the right hand was made especially useful in cleaning out the dish. The practice of employing two hands was primarily due to a multiplication of strings, and that increase was one of the many importations from Asia, or from Egypt. Clemens Alexandrinus says that Psaltērion was a name applied generally to such stringed instruments as

were Egyptian. That would be on account of their larger number of notes requiring the use of two hands. A plectrum was unfitted for playing chords —it could only sound one string at a time, or slip from one to the next.

Psalmos is another name for a Psaltery, and the only distinction that can now be drawn between the two is, that Psalmos implies an instrument made expressly for accompanying the voice, and that the same designation includes any song to be chanted or sung with such an accompaniment. Hence our word Psalm. Whoever may wish to return to the primitive use of psalmody should therefore chant or sing the Psalms, whether he may adopt the one version in prose, or the other in metre. The Psalmos must have had at least ten strings, if not more, because Plutarch speaks of it as an octave-playing instrument.[a] We might infer from his description that the number was much larger, if he had not coupled with it the Phorminx, in the same sentence. We know of no Greek lyre that had more than fifteen strings, and even such a lyre would have been ranked as a Polychordon. On the other hand, we have, at p. 306, a representation of an Egyptian lyre which has seventeen or eighteen strings.

We now arrive at a Greek instrument that must have been originally the true Egyptian harp, but which was afterwards changed in form, and mutilated in compass, by the Greeks. Julius Pollux says that the Epigoneion had forty strings, and that it took its name from Epigonus, who was the first to

[a] "Ἡ *μὲν περὶ ψαλμοὺς καὶ φόρμιγγας ἁρμονία δι' ἀντιφώνοι ἔχει τὸ σύμφωνον.*"—(Plutarch *De Amicit. Multit.*, p. 96, f.)

introduce it.[a] Athenæus adds, upon the authority of Jobas, or Juba,[b] (the learned King of Mauritania, who had been educated in Italy,) that Epigonus brought the instrument from Alexandria, and that he played upon it with the fingers of both hands, instead of the Greek usage of but one hand, and of employing a plectrum with the other.[c] Further, that Epigonus did not confine the powers of his harp to a simple accompaniment for the voice, but introduced chromatic passages, and instituted a chorus.[d] Nevertheless, his example was not followed by the Greeks; for Athenæus adds that the Epigoneion had been transformed into an upright psaltery,[e] although it

[a] Julius Pollux, *Onomastikon*, lib. iv. cap. 9, Sect. 2.

[b] Juba is one of the authors whose descriptions of Greek musical instruments Fétis undertakes to correct; but Juba is in excellent company, with Aristoxenus and others. Fétis uses "une sévère circonspection," so he will not allow that a flute made of lotus may be also called "a flute blown at the side." A *photinx* must not be called a *plagiaulos*.—(*Histoire*, i. p. 285.) Fétis sees in all second names errors of the Greeks, so neither may the Sambuca have a second name. "Jobas se trompe á l'egard de ce dernier instrument, car il lui donne aussi le nom de Lyrophœnix." Again, Aristoxenus is quite wrong, says Fétis, to have drawn any distinction between the Greek Trigōn and the Hebrew Kinnor, because "l'identité de ces instruments est rendue evidente par l'autorité de Diodore de Sicile." But this is not the only castigation for Aristoxenus. "Plusieurs auteurs, au nombre desquels est Aristoxène, ont attribué . . . leur erreur a été causée," &c. Next, Josephus is charged with not having known the meaning of the Hebrew word "Asor." He required infallible Fétis to teach him Hebrew. As to other writers unspecified —"Ils ne meritent aucune confiance." Trust must only be placed in Fétis. These choice specimens have not been sought for far and wide—they are included within about three pages of Fétis's *Histoire Générale de la Musique*. 8vo. 1869. Pages 383 to 386. Fétis had a large library, but either it did not include a Greek Lexicon, or else he did not know the forms of the Greek letters sufficiently to use it. And yet, from assumed superiority over everybody, ancient and modern, and from the number of second-hand quotations, in various languages, introduced into his pages, Fétis must have hoped to pass for a paragon of learning.

[c] Athenæus, lib. iv. 183 d.

[d] Athenæus, lib. xiv. 638 a.

[e] "*Ψαλτήριον ὄρθιον.*"—(Lib. iv. cap. 81, p. 183, d. See also lib. xiv. cap. 42, p. 638, a.)

still retained the name of the attributed inventor. So the ultimate meaning of the word was—an instrument to be played upon with two hands, after the manner of Epigonus.

Any portable instrument having forty strings would necessarily be made of triangular form, on account of the extreme difference of length that was absolutely required between the longest and the shortest string. No other shape was practicable where the diminution was progressive, and the number so large. The transformation of an instrument of forty strings into one of only ten proves that the cultivation of music was not sufficiently advanced among the Greek people, to enable them to appreciate such harmony as arises from many simultaneous sounds. Every one who can now listen with pleasure to the chords upon a harp or a pianoforte is in advance of the average of musical intelligence among the ancient Greeks.

The Greeks had also a second kind of harp, called the Simikion, or Simikon. It had thirty-five strings,[a] but the reason for its name is unknown. All the musical instruments of Egypt must have been known to the Greeks, and yet, as to those which had many strings, we find scarcely a reference to one of them in the works of Greek classical authors, or a representation in their sculptures. As two Octaves are the full average compass of the human voice, so fifteen strings seem to have been the maximum extent of Greek musical instruments. The Simikion, and the Epigoneion in its original form, are rather to be classed among instruments

[a] *Onomastikon*, lib. iv. cap. 9, art. 2.

once known to the Greeks, than among Greek instruments.

The Romans undoubtedly approved the combination of numerous instruments in concert, but rather, as it seems, for their increased loudness, than from any more decided taste for harmony than that of the Greeks. Indeed, both Greeks and Romans sink below the average, when compared either by the standard of the most ancient, or of the modern stages of musical cultivation. This is perfectly natural; for nations so often engaged in war, and especially with intestine wars, could have but little leisure for the more intellectual branches of art or science. The only inventions encouraged, at such times, are those of some new missile for destruction, while the arts of peace die away, rather than make advance. The history of music affords throughout the most perfect proof of this acknowledged maxim.

In consequence of the absence of representations in the sculptures and paintings of Greece and of Italy, we must revert to Egypt for the forms of ancient harps, and there we may indeed find them portrayed to perfection. "Some [Egyptian] harps," says Sir Gardner Wilkinson, "stood on the ground while played, having an even, broad base; others were placed on a stool, or raised upon a stand, or limb, attached to the lower part. Men and women often used harps of the same compass, and even the smallest, of four strings, were played by men; but the largest were mostly appropriated to the latter, who stood during the performance. These large harps had a flat base, so as to stand without a support, like those in 'Bruce's Tomb'; and a lighter kind was also squared for the same purpose, but,

Harpers painted in the Tomb of Rameses III.,

known as Bruce's, or the Harper's Tomb.

when played, was frequently inclined towards the performer, who supported the instrument in the most convenient position."[a] The Egyptian name for the harp was Bouni, having usually the prefix of the article Ta, in the feminine gender for "The."

The preceding highly ornamented harps are copied from paintings in the Tomb of Rameses III., by Wilkinson, whose remarkable accuracy has been so frequently attested by more recent travellers. They are of the greater interest because they exhibit two of the stages of transition from the original shape of a bow to that of a triangle. The one is bent over like the stem of a pliable tree from its trunk, while the larger number of strings upon the other necessitates a nearer degree of approach to the triangular form.

When James Bruce, the celebrated Eastern traveller, first brought home the model of harps of this kind from Thebes, because they had no poles, which were judged necessary to support the fore-arm against the tension of the strings, his account was disbelieved, and he was nick-named the Theban "Lyre." Bruce's truthfulness has been vindicated by every succeeding traveller, and in the most ample manner; but the want of poles to Egyptian harps has nevertheless appeared as a singular deficiency in so advanced a stage of art. On the other hand, it is a satisfactory proof that the bow and bow-string were the models upon which these instruments were originally formed; indeed, we may see the earliest Egyptian harps to have been bow-shaped, as are those of the fourth dynasty, exhibited at p. 65. The bow-shape did not admit of treble strings, and hence the substitution of the triangle.

[a] Wilkinson's *Popular Account of the Ancient Egyptians*, vol. i. p. 111.

Many minor varieties of harp-form will be found in the admirable work from which the last two splendid specimens have been borrowed. In a general history, extracts are necessarily limited to essential varieties in construction, and the *Popular Account of the Ancient Egyptians* is accessible to all. More is to be learnt about the inner life of the Egyptians from Sir J. Gardner Wilkinson's volumes than from the costly and noble works of Lepsius, Rosellini, and others put together. A great lesson is also to be derived as to the rise and fall of nations, and how art, science, and literature, spring up and decline with them. In Sir Gardner Wilkinson's pages we see the character of the Egyptians—a great and free people under their own kings, learned, skilful, inventive, industrious, sportive, and mirthful; also more humane, because more civilized, than any other ancient nation. The Egyptians make no exhibitions of torturing prisoners and flaying them alive, as do the Assyrians—the Egyptians had no gladiatorial fights, like the Romans—human sacrifices had been abolished in the empire of Upper Egypt for ages before Moses was born. Dr. Burney says that the Greeks and Romans made religion an object of joy and festivity, but that the Egyptians worshipped their gods with sorrow and tears. He made this erroneous deduction from a corrupt text of Ammianus Marcellinus, written after the nation had been crushed by five hundred years of slavery. It should be: "The Egyptians have a suppliant, *rather than a sad*, expression of face," and not, "they are *even more sad*."[a] How different

[a] Ægyptii plerique subfusculi sunt, et atrati *magis quam mœsti oris* — not, atrati *magisque mœstiores*." — (Ammianus Marcellinus, lib. xxii. cap. 16.)

is sadness to the song and dance to Ptah, or Vulcan, exhibited at p. 63. Women, we know, are more readily given to tears than men, but even the ladies are there sufficiently happy-looking and cheerful. So late as the end of the first century of our era, Dion Chrysostom speaks of the Egyptians as cheerful and hilarious,[a] although they had a mortal objection to paying tribute. The men had also the credit, a little before that date, of having become expert thieves.[b] The crushing out of such a nation is one of the problems of the world. Josephus, in his answer to Apion, triumphantly accounts for it on the score that the Egyptians were never admitted to citizenship by any of their conquerors. This policy was often reversed in the case of smaller nations, like the Jews, who were less to be dreaded. Whatever may have been the causes, or cause, the Copts, who are but a mixed race, seem now to be the only remaining descendants of the once mighty nation of the Egyptians.

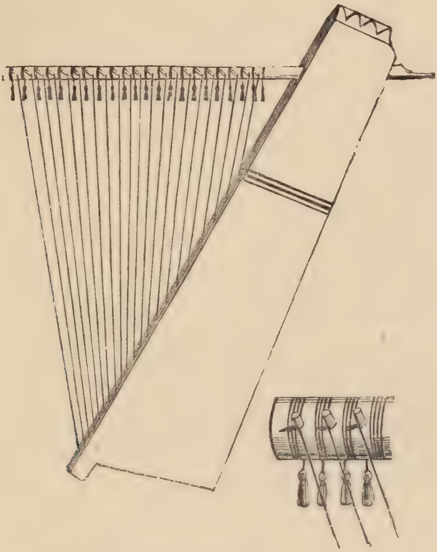
Egyptian triangular harps, or Trigōns, had but a frame on two sides of the triangle, the third side being formed by the lowest string, but the Etruscan had frames complete. A fine example of these will be exhibited in the sequel, under the head of Hebrew Music. They are of the class so much referred to in the middle ages as in the form of the Greek letter *delta*, Δ, and, therefore, as emblematic of the Trinity. The same form is found in Herculaneum.

The Egyptians had triangular harps in great varieties of form. The following is one of twenty-

[a] Γελοίους in the exordium, and ἱλαροὺς at the end of his oration, No. 32.

[b] Diodorus Siculus, lib. i. cap. 80.

one strings, and the original instrument is included in the Paris collection.



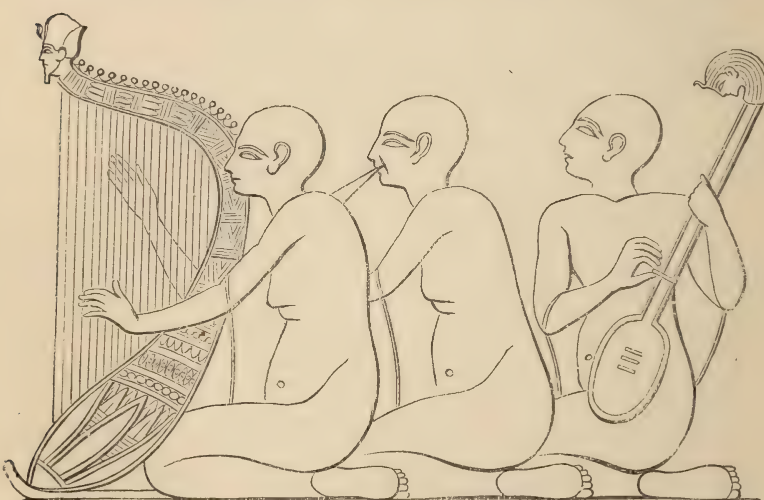
Egyptian Harp in the Paris Collection.

An imaginary Egyptian Trigōn will be found in Wilkinson's *Egypt*, and in Champollion's great work, under the arm of Typhon.[a] In depicting the gods, such license might well be allowed, but some sculptors employed their imagination equally upon musical instruments which they put in the hands of mortals. The Assyrian sculptor, who designed the triumphal procession on the magnificent marble slab, which represents the triumph of their king Asshur-Bani-Pal over the Susians, and which is now in the British Museum, has indulged his fancy rather overmuch in the forms of the harps which the harpers are

[a] Wilkinson's *Popular Account, of the Ancient Egyptians*, vol. i. p. 118, and here, in the sequel, under Hebrew music.

supposed to be playing in the open air, at this celebration. The instruments have no other sounding-boards than one upper bar, and the lower is too weak to bear the requisite tension. They consist of one horizontal and one nearly vertical bar, therefore approaching to a right angle, without support to the corner at which they are joined. If of metal, the harps would give no sound, and if of wood, the strings could not be tuned to an audible pitch without breaking the frame. There are instruments of similar character in Egypt, but the bars and the strings are shorter. We must suppose that, in both cases, one of the bars was large enough to be made hollow, so as to assist the production of tone.

The following elegantly designed harp, in the hands of a blind man, is of smaller size than those in



Blind men playing in concert, on Harp, Double Pipes, and Nefer.

"Bruce's Tomb." We have here a band of blind men, with harp, double pipes, and lute, or Nefer.

The last named instrument has a head, either of a god or of a human being, carved at the extremity; and it may be noted that the old English cittern inherited this characteristic. Music has been a resource for the blind of civilized countries in all ages. In England and Wales blind harpers, who sang ballads to their harps, were once as numerous as are blind organists now. The frequent representations of Egyptian blind men playing or singing in concert prove a system of musical education for the blind in ancient Egypt. The preceding representation is taken from Lepsius's great work,[a] and a second, very much like it, will be found in Wilkinson's *Popular Account*, vol. i. p. 110. The harp has not there quite so many strings, and the central figure is beating time, instead of playing on the pipes.

Small Trigōns, or harps with only four strings, seem to have been used by Roman singers for the sole purpose of taking a pitch for the voice. If tuned to an Octave chord, they would have had one outer string double the length of the other. Horace refers to them in the third Satire of his first book. The subject of the Satire is a celebrated musician, named Tigellius, who was admitted to intimacy by C. Julius Cæsar. The first eight lines of the argument may be stated as follows: — "Singers have all one failing — that they cannot bring themselves to sing to their friends when they are asked, but when unasked they never leave off. This was the case with the Sardinian Tigellius. Even Cæsar himself, though he were to entreat him

[a] Band. vii. Abt. 3, Blat. 236. It is of the twentieth dynasty, and from Thebes—a tomb at Kourna, No. 18.

by his father's friendship, and by his own, could not prevail upon him to sing; but, if Tigellius were in the humour, he would sing convivial songs from the time of egg to that of the apples," or "from the beginning to the end of the repast." Then follows the musical point—

> " . . . . modo *summa*
> Voce, modo hac resonat quæ chordis quatuor *ima*,"

"at one time in the highest pitch of his voice, and at another, in that [pitch] which vibrates lowest in the four strings;" or less literally, "at the pitch of the lowest of the four."

A doubt has long been felt by the learned as to whether "summa voce" is to be taken to denote "highest pitch" in our sense, or "lowest pitch" in the Greek musical application of the word *Hypate*. I submit that the evidence of Nicomachus clears up the doubt, and that the former is the true rendering. I have already shown from his treatise, (see p. 36,) that *Hypate* was the name of a string, or strings, upon the lyre, and had no reference to the *sound* produced by those strings. It or they were simply "highest" by being the *longest* upon the lyre. So the sense of *Nete* and of *Hypate* was not changed in music. The mistake was to think of them as to the notes they produced instead of as mere strings.

The confusion as to the meaning of the two words seems to have originated with Boethius, and is therefore of very long standing. I observed his error while skimming over his treatise after the principles of Greek music had been fixed in my mind. I noted also that the *forte* of Boethius rests in arithmetic of the oldest school of musical proportions, and that

the remainder of his treatise is but indiscriminately copied from Greek writers, without a thorough understanding of the subject. The one inducement to him to write upon music must have been the arithmetical part, so as to form a sequel to his *De Institutione Arithmetica.* He limits his definition of the science of music to the *cognitio rationis*, and declares it to be as superior to the practical branch as the mind is to the body. This is only an apology for his want of practical knowledge, and his *cognitio rationis* should be translated, "acquiring a knowledge of the ratios of intervals," for that is the limit of his acquaintance with the science.[a] Boethius makes such a confusion of terms between *summa* and *ima*, in reference to *Hypate* and *Nete*, and so turns the Greek scale upside down, that I can only transfer the passages to a note.[b] It is strange that he should quote the

[a] See *Inst. Mus.*, i. 34. He writes strongly as to his superior claims upon this point: "rationis expers servitio degit," &c.

[b] Turning to p. 209 of Teubner's edition, part of cap. 20 of lib. i., line 3, "hypate quidem hypaton vocatæ sunt, quasi maximæ magnarum aut gravissimæ gravium, aut *excellentes excellentium*." These last are the hyperboleon, or highest tetrachord, under its Latin name. So here is fine choice for a reader—"The *hypates* are either the largest of the large strings, and so gravest of the grave, or else they are the *smallest and most acute*." (He himself identifies excellentes with hyperboleas, in cap. 26, at p. 219.) Next, on the same page, 209, line 17—"Sed quoniam inter *superius* tetrachordum, quod est *hypate hypaton*," &c.; "et inter *infimum quod est paramese*," &c. Here the scale is turned upside down to make *paramese* below *hypate hypaton*. *Paramese* is above *Mese*, and *hypate hypaton* ought to be the lowest in the scale. Again, lines 24 and 25, "inter hoc mesen tetrachordum et *inferius* quod est netarum." There are no *Netes* below *Mese*. He has still the scale topsy-turvy. There is nothing like sanction, in any Greek author, for anything of this kind. The above are from one small page, and will probably suffice to show that Boethius had but an imperfect understanding even of the Greek scale. Yet, because he wrote in Latin, instead of in Greek, his treatise has been the one always adopted to teach Greek music, even in our Universities.

very paragraph from Nicomachus, comparing the seven planets to seven strings of the lyre, and yet not discover the meaning of *Nete* and of *Hypate*. His treatise, which has now been regarded as a grand authority for many ages, has really been the prime cause that the subject of ancient music has been so generally misunderstood.

CHAPTER XIII.

Organs: Why the Hydraulic Organ was an enigma to lookers-on. —Invented in the third century B.C.—Athenæus's error as to the date.—Herōn first describes it.—Vitruvius and his commentators. — The light touch of the Organ. — Burney and Hawkins give up the attempt to understand the Hydraulic Organ.—The supposed difficulties explained.—An application of the power of water no longer in use. —Why the water was supposed to be boiling. —A condensing syringe used for bellows. —A Greek altar with its raised rim and extinguisher.—Herōn's description translated.—Vitruvius paraphrased.—Organs of 8 stops in use B.C.—Use of hollow vessels to reproduce tone in theatres.—Competitions of organists and their medals.—Two Latin idioms.—Verses to represent organ pipes.—Antiquity of the Pneumatic Organ.—Ancient bellows.—Organs on the Obelisk of Theodosius.—Julian's epigram, and other notices.

ORGANS of two kinds were known to the ancients. One was the "Pneumatic Organ," which was blown by bellows fashioned very much in the present style, and the second was popularly called the "Hydraulic Organ" (in Greek, Hydraulis, or Hydraulikon Organon). In spite of its name, this second instrument was decidedly not hydraulic, although it bore the appearance of being so.

The Hydraulic Organ was always an enigma to superficial observers. They saw water bubbling up from the bottom of an open vessel, and the water in the perpetual interchange of rise and fall, and of rolling or tumbling about. They saw a piston working in a cylinder, and at every stroke of the piston the water rose higher in the vessel. Hence they concluded, naturally enough, that it was water which was undergoing the process of injection into

the pipes of this organ, and that the effects were produced by means of that syringe-like pump. But it was simply a condensing syringe acting upon air.

Ctesibius, the Egyptian, was the inventor, and the date of this one of the several inventions attributed to him may be fixed within the reign of Ptolemy Philadelphus, or between the years 284 and 246 B.C. The question may one day arise as to whether all these were the inventions of Ctesibius, or whether he was but the medium of communicating Egyptian science to the Greeks.

The biographer of Philōn, the celebrated mechanician of Byzantium, in Dr. W. Smith's *Dictionary of Greek and Roman Biography and Mythology*, has relied upon a statement by Athenæus, that Ctesibius flourished in the reign of Ptolemy Euergetes II. He has therefore dated three important men in the history of science a full century or more too near to our own times, viz., Ctesibius, Philōn, and Herōn of Alexandria. Athenæus was undoubtedly mistaken when he wrote Euergetes II. It should have been Euergetes I.; but, as he was recounting an historical event of five hundred years before his own time, Athenæus was liable to such slips. Euergetes I. succeeded Ptolemy Philadelphus, but the invention of the organ must be referred to the earlier of the two reigns.

An epigram, by Hedylus, fixes the date conclusively, and a copy of this epigram is included in Athenæus's own book.[a] He must therefore have forgotten it when he wrote Euergetes II. Hedylus therein alludes to the temple of Arsinoē, to the Hydraulic Organ, and to Ctesibius as its inventor.

[a] *Deipno-Sophists*, lib. xi. cap. 97, p. 497.

This Hedylus was the rival of Callimachus, who was librarian to Ptolemy Philadelphus, or Ptolemy II. Upon the authority of Hedylus, or even upon that of the epigram alone, without the name of its author, there can be no reasonable doubt as to the date of Ctesibius. No one would be found to pay homage to the deceased Arsinoē, as to a divinity, after her brother-husband's death.

There is often a difficulty as to the precise meaning of the word "organ" in Greek and in Latin, when it is unaccompanied by further explanation. Any simple mechanical invention, musical or otherwise, was an organ. Ordinarily, the best translation is the first of those given by Liddell and Scott, "an instrument;" for it might be a surgical instrument; or it might be a musical instrument, such as a simple pipe; or even an organ of sense, as the *instrument* of reasoning, or of other power. Vitruvius draws a distinction between an organ and a machine, as that a machine requires the labour of several persons, or a greater exertion of power by one than is required for an organ; whereas all the powers of an organ may be exhibited, without any especial exertion, by one alone.[a] It is not, therefore, to be inferred, as it has been by some musical writers, that a Greek *organon*, or a Latin *organum*, must necessarily mean a musical instrument; but rather that every manufactured musical instrument *might* be included under the designation of *organon*.

[a] "Inter machinas et organa id videtur esse discrimen, quod machinæ pluribus operis, aut vi majore, coguntur effectus habere; uti balistæ, torculariorumque prela. Organa autem unius operæ prudenti tactu perficiunt quod propositum est; uti scorpionis, seu anisocyclorum versationes. Ergo et organa et machinarum ratio ad usum sunt necessaria, sine quibus nulla res potest esse non impedita."—(Vitruvius, lib. x. cap. 1.)

The first full description of the Hydraulic Organ is by Herōn of Alexandria, who was a pupil of its inventor, Ctesibius. Ctesibius seems to have flourished only some fifty years after the conquest of Egypt by Alexander the Great; and, not only in that century, but even long after it, all who desired to obtain a thorough knowledge of art or science, such as no European teachers could impart, sought to place themselves under Egyptian masters. Philōn, the mechanician of Byzantium, the site of Constantinople, must also have been to some extent, if not altogether, a pupil of Ctesibius. In his *Belopoiika* he speaks of Ctesibius in the past tense, as having resided in Alexandria, and of his having explained to him the nature of air, and especially its elasticity. He refers also to several inventions by Ctesibius, and, among them, to the Hydraulic Organ. Philōn defines it as a kind of "syrinx played by the hands, which we call hydraulis;" and he adds, that the kind of bellows, by which the pnigeus, or air-condenser, was filled with air, was made of copper.[a] It was, in fact, nothing more than a condensing syringe, which is just the opposite of the modern air-pump, or exhausting syringe; for the first pumps air into a receiver, and the second withdraws the air. The Egyptians had for ages before employed small syringes for injecting embalming fluids into the bodies of the dead.

The second full description of the Hydraulic Organ is by Vitruvius Pollio, in his discursive treatise upon Architecture. The date of this treatise is stated to be between B.C. 20 and 11. Although there have

[a] "Καὶ γὰρ ἐπὶ τῆς σύριγγος τῆς κρουμένης ταῖς χερσὶν, ἣν λέγομεν ὑδραύλην, ἡ φύσα ἡ τὸ πνεῦμα εἰς τὸν ἐν τῳ ὕδατι πνιγέα παραπέμπουσα ἦν χαλκῆ."—(*Vetera Mathematica*, p. 77.)

been numberless commentators upon the works of Herōn and of Vitruvius, the Hydraulic Organ has not been sufficiently explained, and does not seem even now to be fully understood.

I argue thus, from still reading Athenæus's erroneous description quoted by an eminent scholar, in one of the latest English books. Thus, currency is given to the fable of "the pipes having been bent down into water," and "the water being 'pounded' by an attendant." From this it is evident that the mistake of Athenæus has not yet been satisfactorily proved.

Athenæus knew nothing except by hearsay about the Hydraulic Organ, for he goes so far as to assert that it was debated whether it ought to be classed among wind or stringed instruments.[a] If he had understood its construction, he would have ridiculed such a discussion.

Neither Sir John Hawkins nor Dr. Burney, our two recognised musical historians, has rendered any assistance towards correcting the error of Athenæus —they give up the instrument as incomprehensible. Neither does the Hydraulic Organ seem to be better understood in Germany than in England, if an opinion may be formed from the labours of one of the latest exponents of the musical instruments of the ancients. In a work of such a class, some special study of the subject might reasonably be expected, but Herr Volkmann informs his readers that "the pipes of the organ were filled with air through the compression of water enclosed in a bronze receiver, which water boys were stirring about." Also, that "the organ was played upon with difficulty, and

[a] Lib. iv. cap. 75.

with considerable exertion."[a] As to the difficulty of performing upon the instrument, Herr Volkmann seems to have mistaken the labours of the bellows-blower for those of the organist. The organ itself was of very light touch, and the labour of filling it with air fell upon the attendants. As to "the compression *of* water," the learned writer must be understood to mean "compression *of air by* water," which is not over-clearly expressed. The boys did but pump in air; and the air was enclosed under a receiver, into which water had free ingress and egress. Water is practically incompressible.

I shall have occasion to explain the principle of the instrument hereafter, and will now only adduce the evidence of Claudian, as an eye-witness to the lightness of the touch.

In one of his poems, Claudian lauds the organist as "He who, sending forth powerful rolling sounds by *his light touch,* can cause the countless tones, which spring from the graduated multitude of bronze pipes, to resound *to his wandering finger;* and who, by a beam-like lever, can arouse from their depths the struggling waters into song."[b]

These lines are thus versified by Dr. Busby:—

> "With flying fingers, as they lightsome bound,
> From brazen tubes he draws the pealing sound.

[a] "Etsi ægre et magna cum virium intentione tangebatur. Compressione aquæ arcæ æneæ inclusæ, quam aliqui pueri organarii movebant, fistulæ aere inflabantur."—(*De Organis, sive Instrumentis veterum Epimetrum,* p. 150, appended to *Plutarchi de Musica.* Leipzig. Teubner. 1856.)

[b] "Et qui magna levi detrudens murmura tactu,
Innumeras voces segetis modulatus ahenæ,
Intonet erranti digito; penitusque, trabali
Vecte, laborantes in carmina concitet undas."
—(*De Consulatu Fl. Mallii Theodori,* lines 316-319.)

Unnumber'd notes the captive ear surprise,
And swell the thunder, as his art he plies:
The beamy bar is heaved! the waters wake!
And liquid lapses liquid music make."[a]

Claudian refers to one of the large Roman organs dating from the second to the fourth century of our era, and not to those which existed two or three centuries before the commencement of that era. The pipes of the earliest organs were made of large reeds, just as are those of the Chinese at the present time, and not, at first, of bronze. But, from Claudian's description, it appears that the touch of the large Roman organs was equally light; and, indeed, there is no reason that it should have been otherwise, for the key-action of the one must have answered equally well for the other.

One of the ablest commentators upon the Hydraulic Organ, in modern times, is Isaac Vossius,[b] in his *De Poematum Cantu, et viribus Rhythmi*, printed at Oxford in 1673. In this work he gives a partial description of the organ of Vitruvius, and supplies many of the quotations which have since been constantly reappearing in the works of later commentators. During the eighteenth century, perhaps the ablest treatise on the subject was that of Albert Meister, in 1771.[c] It is mainly copied

[a] *General History of Music*, vol. i. p. 220. Dr. Busby wrote "he heaves," which I have ventured to change to "is heaved."

[b] Isaac Vossius is recorded to have been born at Leyden in 1618, and to have passed the latter part of his life in England. He was admitted to an honorary degree at Oxford in 1670, and, about three years afterwards, was made a Canon of Windsor, dying at Windsor Castle in 1688.

[c] Albert Ludov. Frid. Meister, *De veterum Hydraulo* in *Novi Commentarii Soc. Reg. Scientiarum Gottingensis.* 1771. Printed at Gottingen and Gotha in 1772, 4to, p. 158, et seq.

from Vossius. Gottlob Schneider, in his careful edition of Vitruvius, supplied much that was desired towards a correct text of his author, but he does not explain the principle of the organ.

The comments of Vossius, of Albert Meister, and many others, were published before the *Histories* of Burney and of Hawkins. Dr. Burney, remarking upon them, says, "But neither the description of the Hydraulic Organ in Vitruvius, nor the conjectures of his innumerable commentators, have put it into the power of the moderns either to imitate or perfectly to conceive the manner of its construction."[a] And Sir John Hawkins says, "So imperfectly has Vitruvius described it, that to understand his meaning has given infinite trouble and vexation to many a learned commentator."[b] And again, after publishing the Latin text of Vitruvius, from a copy not over-carefully collated, Hawkins adds, "This description to every modern reader must appear unintelligible."[c]

I cannot admit the existence of any such extraordinary difficulties. The descriptions are troublesome, as I found when scrutinizing that of Herōn; but it sufficed for me, after some reflection, to make an experimental Hydraulic Organ, and it answers perfectly. That which is now more wanted than a new translation is an explanation of the principle of the instrument, and I do not doubt but that I can make it intelligible henceforth to every one who may indulge a wish to understand it. A mass of learning has hitherto been expended upon it without any very adequate result.

[a] Burney's *History*, vol. i. p. 491.

[b] Hawkins' *History*, vol. i. p. 69, 8vo.

[c] Hawkins' *History*, vol. i. p. 70, 8vo.

If only a thoroughly good translation of Herōn were wanted, there could not be, so far as I am able to judge, a better than the one included in the English edition of Herōn's *Pneumatika*, or *Spiritalia*, published in 1851. The translation is by Mr. J. G. Greenwood, Fellow of University College, London. Manuscripts must have been carefully collated for the text of that edition.

The principle of the Hydraulic Organ is both simple and ingenious, but it is one no longer in use. To this fact we may trace, at least, one reason why it has not hitherto been generally understood.

I have already said that the name hydraulic is, at least in the modern view, incorrect. There is not one "water-pipe" in the instrument—they are all for air. The Greeks were not far advanced in science when the public gave it this name. The earliest description is in a Greek work on Pneumatics.

The ingenious application of water was but to prevent the possibility of over-blowing the instrument, and thus to save it from the destruction to which the Pneumatic Organ was always liable from that particular cause. Such an improvement was, no doubt, the principal reason for the superior popularity of the Hydraulic over the Pneumatic Organ for many centuries. A second advantage in the Hydraulic Organ was, that the condensing syringe for injecting air took up less space than the Egyptian-shaped bellows, which were trodden by the feet, and which the sculptured Pneumatic Organs on the Obelisk of Theodosius prove to have been continued in use by the Romans down to the fourth century of our era.

The apparatus for supplying wind to the Hydraulic

Organ acted vertically, and not horizontally, as it would in bellows. The upright condensing syringe was worked by a lever from below. It pumped in wind, but no water. It injected air very spasmodically, on account of the elasticity of air, and as a syringe it could act only at intermittent intervals. The distribution of the air was then equalized, and the supply to the pipes was maintained by the pressure of water returning to seek its level under the bronze receiver, from which it had been previously expelled by the air. The receiver was open at the bottom, and, according to Vitruvius, its edges were supported by wedges. Thus the water had free ingress and egress. It is a well-known fact that the pressure of water is alike in all directions, so that it must act equally well upwards or downwards.

The law is that "liquids transmit pressure equally in all directions, and the pressure they produce by their own weight is proportionate to the depth."

And now, for exemplification, take a glass funnel, and turn the broad end downwards in a pan of water. Put a cork under the funnel, and it will float upon the surface of the water. If you then cover the smaller end of the funnel with your lips and blow down it, you will see the cork sink gradually to the bottom of the pan. When it has arrived there, all the water will have been expelled from under the funnel, and, instead of water, it will be filled by the breath from your mouth. The water which you have driven out will necessarily mix with, and raise the height of the outer water, which is around the funnel, in the pan. If you then continue to blow, your breath will only rise in bubbles from

the bottom of the pan to the surface of the water. The elastic force of the increased quantity of air within the funnel has become too great to be further condensed by that insufficient weight of water.

Now, suddenly remove your lips, and put a tiny organ pipe, or whistle, into the neck of the funnel, covering the pipe round with india rubber, or a cork, to make it fit into the neck. As the pressure from your mouth is now withdrawn, and there is a hole through the pipe which permits the escape of the air, the water will return, and in returning under the funnel to seek its level, it will drive up the air that has been enclosed, through the pipe. In doing this it will keep up a continuous sound from the pipe just as if it were blown from the lips. The pressure of the water will continue until it has found its level within as without. The water exercises the pressure of its *weight* upon the air, and the higher the water in the pan, the greater will be that weight. There is hardly a limit to the compressibility and to the elasticity of air, (as witnessed in the pop-gun, and in the air-gun,) but water is not practically compressible, and therefore is not elastic. It exercises only its weight.

This is the simple secret of the pnigeus or air-compresser of the Hydraulic Organ. It is evident from it that the Egyptian inventor understood the compressibility and the elastic power of air, as well as that the pressure of water is equal in all directions.

We may note also an advantage in this system of causing water to return to seek its own level under a solid open receiver. It thus becomes a more powerful agent than if the same amount of water were equally distributed as a weight upon the top

of a drum-shaped receiver having elastic sides, because the water expelled from the pnigeus will raise the height of that in the pan or outer vessel, and "the weight of water is proportionate to its depth."

But the pnigeus, or air-compresser of the organ, had two pipes at the top instead of the one of the funnel, and being made of bronze instead of glass, it was impossible to see into it, as through the glass of the funnel. Suppose, then, that instead of a funnel, you use as an air-condenser a large pewter basin, inverted in a pan of water, and, near to the circular rim, which would support the basin if it were upright, let there be two holes on opposite sides. The first hole is for the insertion of a pliable tube to communicate with the syringe by which the air is to be injected into this condenser, and the second hole is for a somewhat smaller tube, to carry air from this condenser into the organ. If the wind be then injected into the condenser, it cannot escape through the second tube until a key of the organ has been put down, to allow it to pass, and, in passing, to sound a pipe. The only means of knowing whether this condensing receiver is well supplied with air, is to continue blowing until bubbles rise from the bottom of the pan to the surface of the water. Then as much air is inclosed as the pressure of the water will retain. If greater loudness be required from the pipes, it is only necessary to take a deeper receiver, and to add more water in order to increase the weight upon the enclosed air. Under any circumstances, the only way to make sure of having a supply of air in readiness is to see the bubbles rise outwards.

If the pewter basin were deeper, and it were made

of copper or bronze, as was the Greek pnigeus which was used for this purpose, it would resemble a caldron, and the bubbling up of the water from the bottom would, to a superficial observer, strengthen the idea that it was really a caldron, and that the water was boiling.

To that appearance we may attribute the Latin name of *cortina* (the caldron), given to the Hydraulic Organ—as, for instance, in the poem of *Ætna*, of which a superior text has recently been edited, from a Cambridge manuscript, by Mr. H. A. J. Munro, late Professor of Latin in that University.[a]

In the sequel of this book, if it should extend to the Middle Ages, more allusions will be found to the supposed boiling of the water, to make the pipes sound; one, even of as late a date as the twelfth century, in the writings of William of Malmesbury.

It should be added that this pnigeus, or air-condenser, was placed within a pedestal, made in the form of a small altar, being either rounded and like a very short column, or hexagonal with its base in steps. The tops of altars were hollowed out, to prevent the spread of fire, and the pnigeus was a sort of extinguisher for it. The water in the outer rim or basin of the condenser was kept incessantly tossing up and down, because it rose at every fresh injection of air into the condenser, and it fell again

[a] "Nam veluti sonat hora duci Tritone canoro,
Pellit opus collectus aquæ victusque movere
Spiritus, et longas emugit bucina voces,
Carmineque irriguo magnis *cortina* theatris
Imparibus numerosa modis canit, arte regentis,
Quæ tenuem impellens animam subremigat unda:
Haud aliter summota furens torrentibus aura
Pugnat in angusto, et magnum commurmurat Ætna."
—(Lines 293 to 300.)

at every emission of that air through the smaller tube into the organ, whenever the organist touched a key. This accounts for the "toiling and labouring of the water" so often referred to, as by Tertullian and others.

The foregoing full explanation of the air-condenser, air-compresser, or pnigeus, has perhaps been demanded, because this contrivance of ancient science is no longer in use, but the condensing syringe, which supplied the place of the ordinary bellows, acted so much like an ordinary condensing syringe of to-day, that, except perhaps as to the position of the valve, it will be better understood by a glance at a diagram, than from any number of words.

The question then arises as to which of the diagrams is to be offered to the reader. It cannot be one copied from the small antique designs upon medals or gems, because they are too minute to supply the details. It may be desirable to reproduce one further on, not only for the sake of the true external appearance of the Hydraulic Organ, but also for the purpose of presenting to the enquiring public a portrait of one of the laurelled organists of former days. Still, for present use, some one of the mediæval designs must be adopted, such as are found in manuscripts, or in early printed copies of Herōn's *Pneumatika*.

An objection may be raised to the one in *Vetera Mathematica*, and in other editions of Herōn's work, on the following grounds. Either the artist, or the engraver, has so rounded off the ends of tubes, and the mouths of cylinders, in order to improve the picture according to his ideas of the beautiful, and yet, so little in accordance with the description in

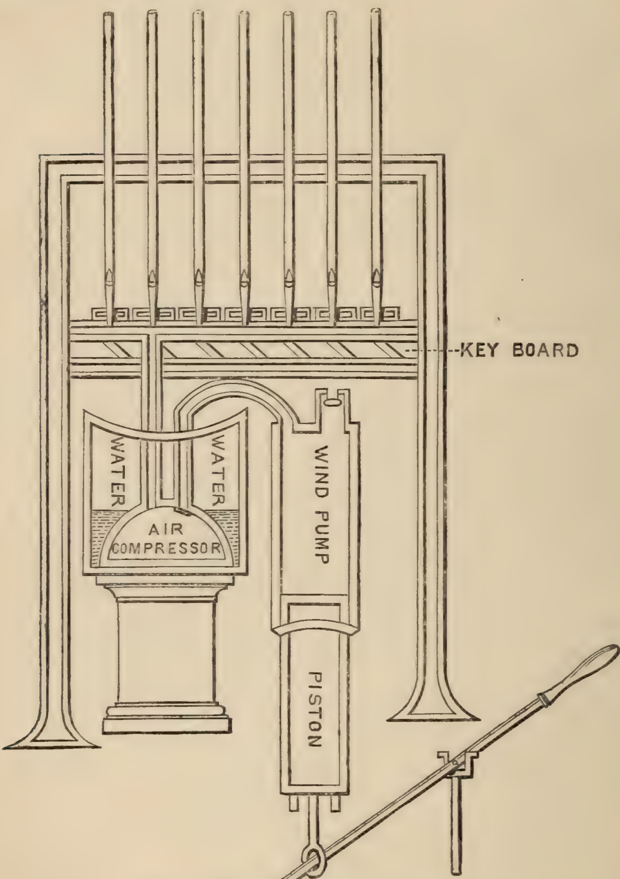
the text, that, instead of elucidating, they only tend to mystify the subject. The worthy man saw that the organ was infinitely larger than the air-compresser, and therefore he gave it a tube four times the size of the other; and yet, in practice, the intermittent action of the condensing-syringe would require a channel double the size of the second tube, which had to convey a continuous and equal flow of air into the organ. Again, he has given a pretty battledore-shaped slide under the mouth of the organ pipe, instead of a straight one. It has at least the merit of being large enough, but how it was to slide in a narrow groove must be a mystery to all enquirers.

Choice is embarrassing, for each artist has had his special proclivities. I have adopted the diagram in the Harleian manuscript, No. 5605, and, *ceteris paribus*, I was perhaps a little influenced in the choice by a curious exhibition of idiosyncrasy on the part of the good monk who must be supposed to have designed it. It appears that he could not induce his pious fingers to draw a heathen altar as a support for anything, and therefore he left the pnigeus dangling in the air. Our less scrupulous artist has supplied the stand, but the reader must not expect to find anything of the kind in the manuscript.

No one of these diagrams is of any authority, the oldest extant copy of the *Pneumatika* not being older than the fourteenth or fifteenth century. The text is the one and only reliable source for elucidation.

It may be well to note that the condensing syringe, or wind pump, must be understood as being detached from the organ; for, in this design, it looks

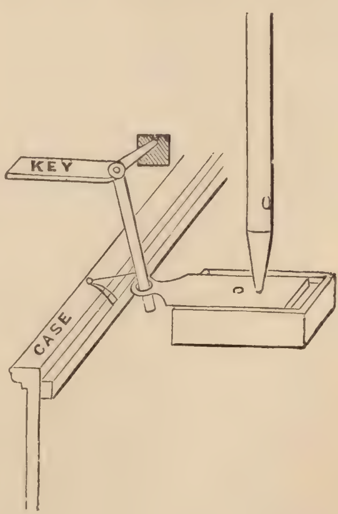
very much as if it were under it; moreover, the condensing syringe, or wind-pump, as here represented, is of most unnecessary grandeur for so small an air-compresser, or pnigeus.



The Hydraulic Organ of Ctesibius.

Instead of the tedious series of three or four letters, one for every angle of each part to be described, I have substituted the names, which seem to be quite sufficient for an intelligent reader. The lever by

which the condensing syringe, or wind-pump, is worked explains itself. The little valve to admit air is at the top of the syringe, in the small box above the shoulder of the larger cylinder in which the piston works. It falls to a restricted distance by its own weight when the piston is down, and so it admits air; and it is closed by the rush of air from below when the piston is suddenly forced upwards. That valve added greatly to the labour of blowing. The most important of subsequent improvements in the Hydraulic Organ was in the form and character of the valve. Instead of being flat, as here, it was made like a cymbal, or of a bell-shape, so as to catch the wind from below more readily. Again, its weight was balanced from the outside, by hanging this bell-shaped valve to a little chain, which was held in the mouth of a dolphin-shaped balance. The dolphin moved upon a centre-pin, and his head went down or up with the bell. So he took off the weight of the valve, and looked like a dolphin sporting. Thus, too, the popular idea of the agency of water was further promoted.



And now as to the key-action of the organ. The diagram is here enlarged in order to show more plainly the "little key with three bent arms," (the ἀγκωνίσκος τρίκωλος). It will be seen

that, when the key is pressed down at its upper extremity by the finger, it will cause the lid of the box to slide on, so as to close it, and thus to bring the little round hole in the lid under the mouth of the pipe, and admit air to it. The box ought to have been inverted, the mouth of the pipe fitted into it, and the slide should act below, instead of above, but then the action could not have been seen.

The box should also have been exceedingly shallow, so as only to take in hautboy reeds, and the lid to slide as in a box for dominos. The shallower the box, the quicker would the pipe speak. The slide is the one important part, and that alone is spoken of by later writers. The wind-chest of the organ included an air-channel under these slides.

When the finger was raised from the key, there was a piece of string, like the tape in a modern pianoforte action, to bring back the key into its place. The string was attached to a spring secured to the case, and this spring was made of elastic horn. It will be seen in the diagram acting upon the lower end of the vertical arm of the key. The action is very simple. The key turns upon a centre-pin, like two spokes of a wheel upon its axle.

It has been argued that the Greeks had no keys to their organs, because such a word as *kleis*, which would express the key to a fastening or lock, is not named in connection with musical instruments. But it should be remembered that we employ the English word idiomatically. Even in Latin, Vitruvius uses *pinna* for an organ-key for playing upon the instrument, and would only adopt such a word

as *clavis* for a key in the literal sense, if it were to lock up the instrument.

The hydraulic action of modern organs does not bear any resemblance to the ancient. The object of the present hydraulic action is only to diminish the weight of the touch.

The following is the invention of Ctesibius, as described by Herōn of Alexandria. I give a free translation, because it will save trouble to all readers. For instance, a word like *kanōn* is here used in half-a-dozen different senses. Any straight rod, beam, pole, or rule of any kind is a *kanōn*, besides its other meanings. Here, it is at one time a piston-rod; next, the beam of a lever; thirdly, the fulcrum upon which the lever works; fourthly, it is a part of the case within the organ. To give at once its precise name saves the reader the trouble of gathering from the description what kind of *kanōn* is there intended. The most tiresome part of all indefinite or technical descriptions is the summing up of an author's words to find out his meaning.

Herōn's *Pneumatika*, or *Spiritalia*, has not been reprinted in Greek for the last two centuries, therefore, that part of the work which contains the description of the Hydraulic Organ is now freed from abbreviations, and subjoined in modern types. The only exception is, as to the three letters, koppa, sampi, and stigma, which are only here employed to denote parts of the instrument, and therefore do not give any trouble :—

"THE CONSTRUCTION OF THE HYDRAULIC ORGAN.[a]

"Let there be a small altar-like pedestal of bronze (αβγδ), containing water. In the water let there be a convex hemisphere, called a pnigeus (εζηθ), retaining a free passage for water underneath it. From and through the top of this pnigeus, let two tubes be carried above the pedestal; one of them (ηκλμ) bending downwards outside the pedestal, and communicating with the box of a condensing syringe (νξοπ), having its mouth downwards, and its inner surface made smooth and true to fit a piston. Let the piston (ρσ) be well fitted into this box, or cylinder, so that no air may escape by its side, and to the piston attach a very strong piston-rod (τυ). Again, to this piston-rod attach a transverse rod (υφ), which shall act as a centre-pin (at υ), and work as a lever upon an upright fulcrum (ψχ), which must be firmly set.

"Into the inverted bottom of the box above described insert another box of small size (ω), with its mouth quite open to the larger, but closed above, and having a hole through the upper part, by which air may enter into the larger box. But under this

"[a] Ὑδραυλικοῦ Ὀργάνου κατασκευή. Εστω τις βωμίσκος χάλκεος ὁ (αβγδ), ἐν ᾧ ὕδωρ ἔστω · ἐν δὲ τῷ ὕδατι κοῖλον ἡμισφαίριον κατεστραμμένον ἔστω, ὃ καλεῖται πνιγεὺς, ὁ (εζηθ), ἔχων ἐν τῷ ὑγρῷ διάῤῥυσιν εἰς τὰ πρὸς τῷ πυθμένι μέρη. Ἀπὸ δὲ τῆς κορυφῆς αὐτοῦ δύο ἀνατεινέτωσαν σωλῆνες συντετρημένοι αὐτῷ οἱ ὑπὲρ τὸν βωμίσκον · Εἷς μὲν, ὁ (ηκλμ), κατακεκαμμένος εἰς τὸ ἐκτὸς τοῦ βωμίσκου μέρος, καὶ συντετρημένος πυξίδι τῃ (νξοπ), κάτω τὸ στόμα ἐχούσῃ, καὶ τὴν ἐντὸς ἐπιφάνειαν ὀρθὴν πρὸς ἐμβολέα ἀπειργασμένην. Ταύτῃ δὲ ἐμβολεὺς ἁρμοστὸς ἔστω ὁ (ρσ), ὥστε ἀέρα μὴ παραπνεῖν. Τῷ δὲ ἐμβολεῖ συμφυὴς ἔστω κανὼν ὁ (τυ), ἰσχυρὸς σφόδρα · πρὸς δὲ τὸν ἁρμόζοντα ἕτερος κανὼν, ὁ (υφ), περὶ περόνην κινούμενος τὴν πρὸς τῷ (υ) · ὁ ἀυτὸς δὲ κηλωνευέσθω πρὸς ὄρθιον κανόνα τον (ψχ) βεβηκότα ἀσφαλῶς. Τῇ δὲ (νξοπ) πυξίδι ἐπικείσθω κατὰ τὸν πυθμένα ἕτερον πυξίδιον τὸ (ω), συντετρημένον ἀυτῇ, καὶ ἐπιπεπωμασμένον ἐκ τῶν ἄνω μερῶν, καὶ ἔχον τρύπημα,

hole let there be a thin plate to close it, and let this plate be upheld by pins passing through small holes made in it, and these pins are to have heads, so that the plate may not fall off. Such a plate is called a valve (*platusmation*).

"The second tube from the top of the pnigeus (ϛζ) is to be carried up to communicate with the transverse channel (ϟϡ), [included in the wind-chest of the organ]. Into this transverse channel the ends of the organ pipes (*ααα*) are inserted, and have their extremities enclosed in little boxes, such as are made to hold hautboy reeds. The orifices of the organ pipes (*βββ*) are left open within them.

"The lids of these boxes are to slide over the orifices of the organ pipes, and they must have holes made in them, so that when the sliding lids are pushed home, the holes in them may correspond with the orifices of the organ pipes; but when the sliding lids are drawn back, they will pass over these orifices and close the pipes.

"Now, if the lever be depressed at its extremity (*φ*) the piston will be raised, and thus expel the air which is enclosed in the box of the cylinder, and the force of that air will close the hole in the little box above it, through its action upon the aforesaid

δἰ οὗ ὁ ἀὴρ εἰσελεύσεται εἰς τὴν πυξίδα. Ὑπὸ δὲ τρύπημα λεπίδιον ἔστω, ἐπιφράσσον αὐτὸ, καὶ ἀνεχόμενον διὰ τρηματίων ὑπό τινων περονίων κεφαλὰς ἐχόντων ὥστη μὴ ἐκπίπτειν τὸ λεπίδιον· ὃ δὴ καλεῖται πλατυσμάτιον. Ἀπὸ δὲ τοῦ (ζη) ἕτερος ἀνατεινέτω σωλὴν ὁ (ϛζ), συντετρημένος ἑτέρῳ σωλῆνι πλαγίῳ τῷ (ϟϡ), ἐν ᾧ ἐπικείσθωσαν οἱ αὐλοὶ συντετρημένοι αὐτῷ, οἱ (α), καὶ ἔχοντες, ἐκ τῶν κάτω μερῶν καθάπερ γλωσσόκομα συντετρημένα αὐτοῖς, ὧν τὰ στόματα ἀνεωγότα ἔστω τὰ (βββ)· Διὰ δὲ τῶν στομάτων τὰ πώματα διώσθω τρήματα ἔχοντα, ὥστε εἰσαγομένων μὲν τῶν πωμάτων τὰ ἐν αὐτοῖς τρήματα κατάλληλα γίγνεσθαι τοῖς τῶν αὐλῶν τρήμασι· ἐξαγομένων δὲ παραλάσσειν καὶ ἀποφρὰσσειν τοὺς αὐλούς. Ἐὰν οὖν ὁ πλάγιος κανὼν κηλωνεύηται διὰ τοῦ (φ) εἰς τὸ κάτω μέρος, ὁ (ρσ) ἐμβολεὺς ἐκθλίψει μετεωριζόμενος τὸν ἐν τῇ (νξοπ) πυξίδι ἀέρα, ὃς ἀποκλείσει μὲν τὸ ἐν τῷ (ω) πυξιδίῳ τρύπημα διὰ

valve. The air can then pass out only through the first tube, and so into the pnigeus; again, out of the pnigeus, along the second tube, into the wind-chest of the organ; lastly, out of the wind-chest of the organ into the pipes, if the orifices in the pipes and the holes in the sliding lids coincide—and that is, when the lids, or some of them, are pushed home.

"Therefore, in order that, when we wish any of the pipes to sound, their orifices may be open, and that, when we wish them to cease, these orifices may be shut, we may do as follows:—

[The Action of the Key.]—"Suppose one of the reed-boxes ($\gamma\delta$) to be separated from the rest, the open part of its sliding lid being δ; the organ pipe above it being ϵ; the entire slide that fits below the organ pipe being ϛρ; and the hole in that slide which is to correspond with the orifice of the organ pipe being η. Then let there be a key with three little bent arms to it ($\zeta\theta\ \mu^1\ \mu^2$), of which the arm ($\zeta\theta$) is attached to the above-named slide (ϛζ), and the key to turn upon a centre-pin at μ^2.

"If we depress with the hand the highest arm of the key in the direction of the open part of the slide

τοῦ προειρημένου πλατυσματίου· χωρήσει δὲ διὰ τοῦ (μλκη) σωλῆνος εἰς τὸν πνιγέα. Ἐκ δὲ τοῦ πνιγέως χωρήσει εἰς τὸν πλάγιον σωλῆνα τόν ([illegible]) διὰ τοῦ (ϛζ) σωλῆνος· ἐκ δὲ τοῦ πλαγίου σωλῆνος εἰς τοὺς αὐλοὺς χωρήσει, ὅταν κατάλληλα εἴῃ κείμενα ἐν τοῖς αὐλοῖς τὰ ἐν τοῖς πώμασι τρήματα, τουτέστιν, ὅταν εἰσηγμένα ᾖ τὰ πώματα, ἤτοι πάντα, ἢ τινὰ αὐτῶν. Ἱνα οὖν, ὅταν προαιρώμεθα τῶν αὐλῶν τινὰ φθέγγεσθαι ἀνοίγηται τὰ ἐκείνων τρήματα· ὅταν δὲ βουλώμεθα παύεσθαι, ἀποκλείηται, κατασκευάσομεν τάδε.

"Νοείσθω ἓν τῶν γλωσσοκόμων ἐγκείμενον χωρὶς τὸ (γδ), οὗ τὸ στόμα ἔστω τὸ (δ)· ὁ δὲ συντετρημένος τούτῳ αὐλὸς ὁ (ε), πῶμα δὲ ἔστω ἁρμοστὸν αὐτῷ τὸ (ϛρ), τρῆμα ἔχων τὸ (η), παρηλλαγμένον ἀπὸ τοῦ (ε) αὐλοῦ. Ἔστο δὲ τις καὶ ἀγκωνίσκος τρίκωλος ὁ ($\zeta\theta\mu^1\mu^2$), οὗ τὸ (ζθ) κῶλον συμφυὲς μὲν ἔστω τῷ (ϛζ) πώματι· πρὸς δὲ τῷ (μ^1) περὶ περόνην κινείσθω μέσην τὴν (μ^2). Ἐὰν οὖν κατάξωμεν τῇ χειρὶ τὸ (μ^1) ἄκρον τοῦ

(δ), we shall push the slide inwards, and when it has reached the end of the box, the hole in the lid will correspond with the orifice of the organ pipe.

"In order that, when we withdraw the hand, the slide may also be withdrawn mechanically, and thus close the communication with the pipe, do as follows:—

"Rather lower than the reed-boxes, but at the level of, and parallel to, the wind-chest, let a rod (μ^4 μ^5) be carried along, and to this rod fix slips of horn, elastic and curved, one of which (μ^6) is opposite to the reed-box ($\delta\gamma$).

"From the top of this piece of horn let a catgut string, well secured to it, be carried round the extremity of the key (θ), [the point of the lower angle of the key,] so that, when the sliding lid is pushed in the opposite direction, the string may be tightened. Then, if we depress the upper part of the key at its extremity (μ^2), we drive home the lid of the box, and the string draws after it the end of the piece of horn, so as to straighten it by this traction.

"But when the hand is withdrawn from the key, the horn, by returning to its original form, draws back the slide away from the mouth of its box, so as to overlap and cover up the hole in the end of the organ pipe.

ἀγκωνίσκου ἐπὶ τοῦ (δ) στόμιου τοῦ γλωσσοκόμου, παρώσυμεν τὸ πῶμα είς τὸ ἔσω μέρος · ὥστε, ὅταν ἐμπέσῃ είς τὸ ἐντὸς μέρος, τότε τὸ ἐν αὐτῷ τρῆμα κατάλληλον τῷ τοῦ αὐλοῦ γίνεσθαι. Ἵνα οὖν ὅταν ἀφέλωμεν τὴν χεῖρα, αὐτόματον τὸ πῶμα ἐξελκυσθῇ, καὶ παραλλάξῃ τὸν αὐλὸν, ἔσται τάδε. Ὑποκείσθω ὑπὸ τὰ γλωσσόκομα κανὼν ἴσος τῷ ([illegible]) σωλῆνι, καὶ παράλληλος αὐτῷ κείμενος ὁ (μ⁴μ⁵) · ἐν δὲ τούτῳ ἐμπεπηγέσθω σπαθία κεράτινα εὔτονα καὶ ἐπικεκαμμένα, ὧν ἕν ἔστω τὸ (μ⁶) κείμενον κατὰ τὸ (δγ) γλωσσόκομον. Ἐκ δὲ τοῦ ἄκρου αὐτοῦ νευρὰ ἀποδεθεῖσα ἀποδεδώσθω περὶ τὸ (θ) ἄκρον, ὥστε ἔξω παρωσθέντος τοῦ πώματος τετάσθαι τὴν νευρὰν. Ἐὰν οὖν κατάξαντες τὸ (μ²) ἄκρον τοῦ ἀγκωνίσκου παρώσομεν τὸ πῶμα είς τὸ ἔσω μέρος, ἡ νευρὰ ἐπισπάσεται τὸ σπαθίον, ὥστε ἀνορθῶσαι τὴν καμπὴν αὐτοῦ βίᾳ · Ὅταν δὲ αφῶμεν, πάλιν τὸ σπαθίον είς τὴν ἐξ ἀρχῆς τάξιν καμπτόμενον, ἐξελκύσει τὸ πῶμα τοῦ στόματος, ὥστε παραλλάξαι τὸ τρῆμα.

"A contrivance of this kind being applied to the box under each of the pipes, when we wish some of the pipes to sound, we must press with the fingers the key of each; and when we do not wish them to sound, we withdraw the fingers, and then the pipes from which the slides are drawn away will cease to sound.

[THE PRINCIPLE OF THE INSTRUMENT.]—"Water is poured into the stand in order that the superabundant air—I mean that which, when driven out of the cylinder, raises the height of the water in the stand—may be retained within the pnigeus, so that the pipes shall always have a supply in readiness to enable them to be sounded.

"When the piston ($\rho\sigma$) is raised, it drives the air out of the cylinder, as already explained, into the pnigeus; and when the piston is depressed, it opens the valve in the little box above it, by which means the cylinder is refilled with air from without. So that, when the piston is again forced up, it will again drive air into the pnigeus.

"It is better that the piston-rod ($\tau\upsilon$) should work round a centre-pin at τ [where it joins the lever], and this by means of a ring in the bottom of the piston-rod, through which the centre-pin [formed

"Τούτων οὖν καθ' ἕκαστον γλωσσόκομον γενηθέντων, ὅταν βουλώμεθά τινας τῶν αὐλῶν φθέγγεσθαι, κατάξομεν τοῖς δακτύλοις τὰ κατ' ἐκείνους ἀγκωνίσκια· ὅταν δὲ μηκέτι φθέγγεσθαι βουλώμεθα, ἐπαροῦμεν τοὺς δακτύλους, καὶ τότε παύσονται τῶν πωμάτων ἑλκυσθέντων.

"Τὸ δὲ ἐν τῷ βωμίσκῳ ὕδωρ ἐμβάλλεται, ἕνεκα τοῦ τὸν περισσεύοντα ἀέρα ἐν τῷ πνιγεῖ, λέγω δὴ τὸν ἐκ τῆς πυξίδος ὠθούμενον, ἐπαίροντα τὸ ὕδωρ συνέχεσθαι, πρὸς τὸ ἀεὶ ἔχειν τοὺς αὐλοὺς φθέγγεσθαι.

"Ὁ δὲ (ρσ) ἐμβολεὺς ἐπαιρόμενος μὲν ἐπὶ τὸ ἄνω, ὡς εἴρηται, ἐξωθεῖ τὸν ἐν τῇ πυξίδι ἀέρα εἰς τὸν πνιγέα· καταγόμενος δὲ ἀνοίγει τὸ ἐν τῷ πυξιδίῳ πλατυσμάτιον· δι' οὗ ἡ πυξὶς ἀέρος ἔξωθεν πληροῦται· ὥστε πάλιν τὸν ἐμβολέα ἀνωθούμενον ἐκθλίβειν αὐτὸν εἰς τὸν πνιγέα.

"Βέλτιον δὲ ἐστι καὶ τὸ τὸν (τυ) κανόνα περὶ περόνην κινεῖσθαι πρὸς τῷ (τ)

by the end of the lever-rod] must pass, in order that the piston may not be twisted, but rise and fall vertically."

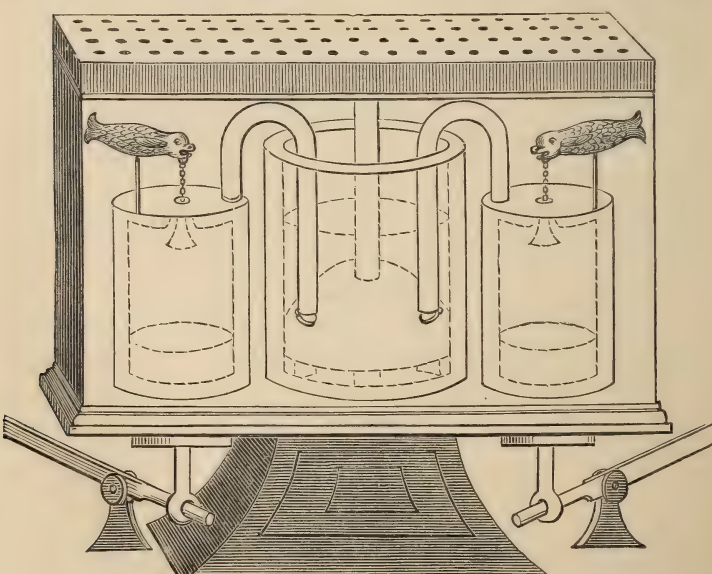
Between the age of Herōn and that of Vitruvius, there is not perhaps any extant notice of the Hydraulic Organ which will throw additional light upon its construction. The description of Vitruvius is ample for those who have some previous knowledge of the instrument; but it has the fault of being too briefly expressed to be intelligible to others who have not had that experience. It is evident, from the concluding passage of his chapter, that Vitruvius did not anticipate any better result from his labours. At least four attempts have been made to translate his work into English, but all have failed at this point. The last two are by Newton and Gwilt. Newton leaves the hard words as they stand in the original, trusting that their meanings may be discovered by the reader. He writes of the "little *cistern* which supports the head of the machine," instead of the *wind-chest* of the organ, and of "brass *buckets* with movable pistons." The late Joseph Gwilt, who was learned in music of the Madrigalian era, has nevertheless misconceived the Hydraulic Organ. He translates *manubreis ferreis* "with iron finger-boards," (instead of "with iron handles,") although, in the next line, these handles are to be turned round.

For these reasons, the first object of a new

διτορμίας οὔσης ἐν τῷ πυθμένι τοῦ ἐμβολέως ἁρμοσθήσεται, δι' ἧς δεήσει περόνην διωθεῖσθαι, πρὸς τὸ τὸν ἐμβολέα μὴ διαστρέφεσθαι, ἀλλ' ὀρθὸν ἀνωθεῖσθαι τε καὶ κατάγεσθαι."

attempt should be to write so explicitly as to make it possible that every one may understand. I therefore amplify the description of Vitruvius, and appeal rather to his words, to justify the construction I have put upon them, than offer such a literal translation as may hereafter be made by any one, with the assistance of the paraphrase. The sentences of Vitruvius are exceedingly long and interwoven, and I have therefore divided them into parts. Further than this—Vitruvius having two condensing syringes, or wind-pumps, to his organ instead of one, describes each part of them in the plural number. He thus complicates his explanations; but as the two are alike, it suffices to describe one, and to reserve plurals for parts of that one.

The accompanying diagram is mainly a copy from one made by Isaac Vossius for his *De Poematum Cantu et Viribus Rhythmi.* Vossius's dolphins are



made to work by the tail instead of by the head, because the text that he followed had *ex ære*, instead of *ex ore.* He therefore referred those words to the cymbals; but as cymbals were invariably of metal, the addition of *ex ære* would have been superfluous. Isaac Vossius understood the instrument, but as he was treating upon another subject, he did not complete his explanation. Again, he wrote in Latin, like Vitruvius, and so he left some technical difficulties which neither Dr. Burney nor Sir John Hawkins[a] could master.

THE HYDRAULIC ORGAN DESCRIBED BY VITRUVIUS.

De hydraulicis autem quas habent ratiocinationes, quam brevissime proximeque attingere potero, et scriptura consequi non prætermittero.	But I will not omit to touch, as briefly as possible, upon the plan of the Hydraulic Organ, and to express, as well as I can in writing, the principle of its construction.
De materia compacta basi, ara in ea, ex ære fabricata, collocatur.	A bronze altar-shaped pedestal is set upon a basis of timber.
Supra basim eriguntur regulæ dextra ac sinis-	Upon this same basis are straight bars of wood,

[a] Sir John Hawkins had no faith in Vossius, because he wrote that the *ascaules* and *utricularii* of ancient times were organists and *not* bagpipers. I do not doubt that Sir John was right in his correction of Vossius upon that point. No one of the passages that I have seen would justify the application of either of the above names to an organist. He is more reverently spoken of, as the skilled musician, or the master. Theodoret uses the word *askoi*, (literally, hides of animals,) for bellows; but instead of the organist being *askaulēs*, he terms him the artist or musician (*technitēs*) in the same sentence. In the quotation to follow from Suetonius, about Nero, the Hydraulic Organ is named first, and the bagpipe last. The bagpipe follows after the hautboy, or other pipe for accompanying choruses.

tra, scalari forma compactæ,	shaped like the sides of ladders, and erected both on the right and on the left of the pedestal. The
quibus includuntur ærei modioli,	bronze cylinders of two condensing syringes, (one on each side,) are maintained in an erect position by these bars. Each of these cylinders has a
fundulis ambulatilibus, ex torno subtiliter subactis;	movable piston, which has been carefully turned by the lathe. The piston
habentibus fixos in medio ferreos ancones,	has an iron elbow-joint fixed into its centre [at the lower end]. The
et verticulis	vertical arm of this elbow is formed by the piston-rod; and the horizontal
cum vectibus conjunctos,	arm by a lever, the end of which passes through the handle of the piston-rod, and thus becomes the centre-pin by which the piston-rod is raised or depressed. It is
pellibusque lanatis involutos.	covered with unshorn sheepskin [to prevent noisy action].
Item, in summa planitia, foramina circiter digitorum ternum, quibus foraminibus proxime, in verticulis collocati,	In the top of each of the cylinders is a circular hole, of about the size to admit three fingers; and immediately above this

ærei dolphini,	hole is a bronze dolphin, which is balanced upon a centre-pin passing through its middle. The
pendentia habentes catenis	dolphin holds in its mouth a little chain, which is attached to a small convex metal cymbal, with
cymbala ex ore,	a flat edge or margin [like a modern cymbal].
infra foramina modiolorum celata.[a]	The cymbal is hidden within the cylinder, [it being just below the hole so that the first puff of air from below will cause it to stop the hole].
	And now, as to the altar-shaped pedestal. In
Intra aram, quo loci aqua sustinetur, inest pnigeus uti infundibulum inversum.	the upper part, where water is maintained, is the air-condenser, called pnigneus, which is of a convex form, like an inverted funnel. Under
Quem subter taxilli alti circiter	the pnigeus are wedges, which, in height, are about equal to the

[a] In the manuscripts of the 9th and 10th centuries (*Hart.* 2767 and 3859), this word is calata, in after times changed into *ca*l*ca*ta, and next into *cha*lata. These were attempts to correct, but the only word to make good sense is celata, and I do not doubt its being the right word. As for chalata, from *χαλάω*, to loosen, or let down, the cymbal was too large to be let down; it could only be drawn up through the open end of the cylinder. It could be let down afterwards; and so we find calantes, or chalantes, rightly enough in the other part of the description.

digitorum ternum suppositi, librant spatium imum,	breadth of three fingers, and they maintain a free space below, for the passage of the water be-
inter labra pnigeos	tween the lower edges of the pnigeus and the
et aræ fundum.	bottom of the vessel.
Supra autem cerviculam ejus coagmentata arcula sustinet caput machinæ,	Above the neck of the pnigeus is the wind-chest for all the pipes, which sustains the upper part of the organ. The wind-
quæ græcè κανὼν μουσικὸς appellatur.	chest is called in Greek "The regulator of the music" (*Canon musicus*).
In cujus longitudine canales;	In the wind-chest are air-channels running longitudinally;
si tetrachordos est fiunt quatuor; si hexachordos, sex; si octochordos, octo.	four air-channels if for four stops; six for six stops; and eight for an eight-stopped organ.
Singulis autem canalibus singula epistomia sunt inclusa, manubriis ferreis collocata. Quæ manubria cum torquentur, ex arca patefaciunt nares in canales.	Each of these longitudinal air-channels is shut in by its stop, which is worked by an iron handle. When one of the handles is turned round, it admits air from the wind-chest into that channel or groove.
Ex canalibus autem canon habet ordinata in transverso foramina, respon-	These air-channels have transverse holes in them, which open into corresponding

dentia naribus quæ sunt in tabula summa; quæ tabula græcè πίναξ dicitur.	holes above in the table-board, or sound-board of the organ, which is called in Greek "The Register-table" (*pinax*).
Inter tabulam et canona regulæ sunt interpositæ,	Sliders are interposed between this register-table and the wind-chest; and these sliders are
ad eundem modum foratæ,	pierced through with holes which correspond in size with the transverse holes above-named.
et oleo subactæ, ut faciliter impellantur introrsus, et rursus reducantur.	The sliders are oiled, in order that they may easily be pushed in and withdrawn.
Quæ obturant ea foramina, plinthidesque appellantur.	These sliders are for stopping the holes, and they are technically called "The Plinths," as each forms a kind of basement to an organ pipe. (*Plinthides.*)
Quarum itus et reditus alias obturat, alias aperit terebrationes.	Their sliding in and out will one way open, and the other way will close the holes that have been bored for air-passages.
Hæ regulæ habent ferrea choragia fixa et juncta cum pinnis;	These sliders have iron conductors fixed to them, and connected with the keys of the organ. Then,

quarum pinnarum tactus motiones efficit regularum.

Continentur supra tabulam foramina, quæ ex canalibus habent egressum spiritus.

[Iis] sunt anuli agglutinati, quibus lingulæ omnium includuntur organorum.

E modiolis autem fistulæ sunt continenter conjunctæ pnigei;

cervicibus pertingentesque

ad nares quæ sunt in arcula; in quibus asses sunt ex torno subacti, et ibi collocati. Qui cum recipit arcula animam, spiritum non patiuntur, obturantes foramina, redire.

the touching of a key will cause a corresponding movement of its slider.

On the upper side of the before-named register-table are the holes through which the air must make its egress from the air-channels into the pipes. These holes have rings fixed in them, into which rings the orifices of all the pipes are inserted.

And now, to revert to the cylinder of the condensing syringe. Each cylinder has a tube running from it to connect it with the pnigeus, in which the air is condensed, and out of the pnigeus through its neck, (which is formed by a short tube,) up to the orifice of the wind-chest, over which orifice a well-turned valve is placed. When the wind-chest has received its supply of air, this valve closes the orifice, and does not permit the air to return.

Now, to go back to the

Ita, cum vectes extolluntur, ancones deducunt fundos modiolorum ad imum. Delphinique, qui sunt in verticulis inclusi, chalantes in os cymbala, replent spatia modiolorum.

Atque ancones, extollentes fundos intra modiolos vehementi pulsos crebritate, et obturantes foramina cymbalis superiora, aëra, qui est ibi clausus, pressionibus coactum, in fistulas cogitur. Per quas in pnigea concurrit, et per ejus cervices in arcam. Motione vero vectium vehementiore, spiritus frequens compressus,

lever. When the handle is raised, it depresses the elbow-joint of the piston, which is at its opposite extremity, and thus it brings down the piston of the air-cylinder to its lowest point. Then the dolphin which, as before said, is set upon a centre-pin, lowers the cymbal which hangs from its mouth, and thus refills the cylinder with air.

On the other hand, when the lever raises the piston-rod, and the piston is worked with vigorous frequency, it closes the hole above the cymbal, and then the enclosed air is driven, by the pressure of the piston, into the tube. Through the tube the air passes into the pnigeus, and from the pnigeus, through the second tube, into the wind-chest. By continued vigorous movement of the lever, the air being frequently compressed, it

epistomiorum aperturis influit, et replet anima canales.

flows through the apertures left open by the organ stops, and refills the air-channels that are included in the wind-chest with air.

Itaque cum pinnæ, manibus tactæ, propellunt et reducunt continenter regulas, alternis obturando foramina, alternis aperiundo, ex musicis artibus, multiplicibus modulorum varietatibus, sonantes excitant voces.

Therefore, when the keys of the organ are touched by the hands, they continually propel and bring back the sliders, alternately closing and opening the holes. Thus, by the art of music, these pipes send forth their resounding tones, with manifold varieties of modulations.

Quantum potui niti, ut obscura res per scripturam dilucidè pronunciaretur contendi; sed hæc non est facilis ratio. Neque omnibus expedita ad intelligendum præter eos qui in his generibus habent exercitationem. Quod si parum intellexerint e scriptis, cum ipsam rem cognoscent, profecto invenient curiose et subtiliter omnia ordinata.—

I have endeavoured, to the best of my ability, to explain this obscure subject in writing; but it is not an easy matter. Neither will this explanation be intelligible to all, beyond those who have had some practice in things of this kind. But if they can understand but little from this description, yet, when they know the thing

(Lib. x. cap. 8; *olim*, cap. 13.)

itself, they will certainly find every part of it to be curiously and ingeniously arranged.

From the above it will be evident that there were organs with four, six, and eight stops before the birth of Christ; and, as a consequence, that they had different qualities of tone. The reed principle was so fully understood, and so much in favour, that its application to the organ cannot reasonably be doubted. Organ pipes must have had sliders to close or open them, and when there was any music worthy of the name, these sliders could only have been managed by the fingers acting upon keys.

Before parting with Vitruvius, a few words may be said about the metal vessels fixed in open spaces among the seats, or otherwise near to the audience, in Greek theatres, which vessels he describes in his fifth book. They were an ingenious and scientific contrivance for assisting both voice and instrument, and the principle upon which they were constructed may be thus familiarly explained.

It is a well-known fact that, when a harp and a pianoforte are in the same room, and in precise tune together, a chord struck upon the pianoforte will produce a corresponding chord from the harp. The sound-waves that the pianoforte has set into vibration have reached the strings of the harp, and they have sufficient power to excite new sounds in unison with them, from the tightly drawn strings of the harp. The effect will be the same with two pianofortes if the dampers are up, and with other instruments. This principle was well understood

by the ancients. It is referred to both by Aristotle and by Aristides Quintilianus. It differs from echo, which is but a reverberation of one sound. The main body of sound travels like a billiard ball, and it will either be returned or deflected according to the angle at which it strikes the object.

The Greek vessels in theatres were for the purpose of utilizing this waste power. The sound-waves that were acting upon the ear of the listener were at the same instant exciting new waves of sound from another body, by setting it also into vibration as a sound-board, when they would otherwise have been deflected, or had travelled away.

The vessels must have had either a contracted edge or lip, or else a hole in them. Sound may be produced from air set in vibration by the edge of a reed, as in a pandæan pipe; or from the lip of a phial, or from the hole in a flute; but no sound will ensue from blowing into a tea-cup. In that case the breath will only be deflected. It requires the strong friction of a wet finger round the edge of a tea-cup, or of a finger-glass, to set so wide-mouthed a body into vibration.

The vessels thus set round the theatre were tuned to the different notes of scales, even to quarter-tones, because each vessel could produce but one note. It is strange that this scientific contrivance should not have been utilized in any way by the moderns, with the well-known fact of the harp and pianoforte before them. Surely it is preferable to reverberation, both from its adding power, and from its simultaneousness.

About eighty years after Vitruvius wrote, improvements were made, or attempted, in the

Hydraulic Organ, but the nature of those improvements is nowhere explained. Suetonius reports of the Emperor Nero that, having finished a consultation hurriedly when his enemies were approaching, he passed the remainder of the day in exhibiting and in discussing the properties of Hydraulic Organs of a new kind, which he had resolved to bring out.[a] Just before his death, Nero vowed that, if he escaped the danger then threatening him, he would appear upon the stage to contend for victory on the Hydraulic Organ, on the pipe for accompanying choruses, and on the bagpipe; also that, on the last day of the games, he would appear as an actor and as a dancer.[b] All these delights were lost to the Romans by his enforced suicide.

There are extant medals of the reign of this Emperor, and of several other Roman Emperors, which were given for victories gained in public contests of organ-playing upon the Hydraulic Organ. One such medal, of the time of Nero, is in the British Museum, and it has on one side the head of the Emperor, with the inscription, "Imp. Nero Cæsar Aug. P. Max." The letters are, as usual, in capitals, without stops between them. If in full, it would have been, "Imperator Nero, Cæsar Augustus, Pontifex Maximus." He was indeed a strange

[a] "Transactaque raptim consultatione, reliquam diei partem per organa hydraulica novi et ignoti generis circumduxit; ostendensque singula, de ratione ac difficultate cujusque disserens, jam se prolaturum omnia affirmavit, si per Vindicem liceat."—(Suetonius, *Nero*, 41.) C. Julius Vindex was then marching with an army against Nero.

[b] "Sub exitu quidem vitæ palam voverat, si sibi incolumis status permansisset, proditurum se pro parte victoriæ ludis, etiam hydraulam, et choraulam, et utricularium; ac, novissimo die, histrionem, saltatoremque Virgilii turnum." — (Suetonius, *Nero*, 54.) Macrobius defines *Virgilii turnum* as "*canticum* saltare."

specimen for a high priest. On the reverse of the medal is the portrait of the victorious organist, and the inscription, "Laurenti nica,"[a] (The victory of Laurentius). The victor stands beside his organ, with a branch of laurel raised high in his right hand. Laurel is upon the front of the organ, and on the further side from the organist also are two branches, where one of the condensing syringes should be. The limit of space did not permit the introduction of either of the condensing syringes into the medal.

There are other such medals of the reigns of the Emperors Trajan, Caracalla, and Valentinian, in the same collection. The last-named has the inscription "Placeas Petri." In that we have a side view of the organist who is seated, and of two organ blowers who are working at the condensing syringes, one on each side of the organ. A front row of nineteen pipes is to be seen; but, in all such cases, the number of pipes has been restricted by want of space. Engravings from medals of the same class, and copied from coins which are extant in foreign cabinets, are depicted in *Description General des Médaillons contorniates*, by J. Sabatier.[b] In describing one of the time of the Emperor Trajan, Sabatier has mistaken the laurel of the victor for a *flabellum*.

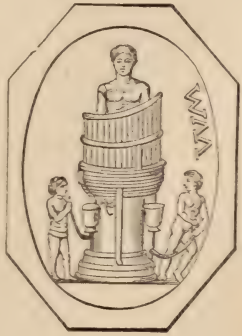
In spite of these medals being "contorniate,"[c] or "having an outer rim turned by the lathe, and raised to protect them," they are much worn, and consequently indistinct. They are all seemingly of

[a] Greek, *νίκη*, victory. "Nica," says Dr. W. Smith, "a cry with which each party in the circus encouraged its favourite combatant."—(Latin Dict. sub *nica*).

[b] Paris, 4to. 1860. plate x.

[c] Italian, contorno. French, contour.

copper, which is much softer than bronze. For this reason, I select an example from an antique gem. It is a cornelian intaglio, formerly in the Hertz Collection, and now in the British Museum. As it would be too minute to be distinct if exhibited in the gem size of the original, it has been enlarged by our artist. He could not determine the character of the ornament upon the pedestal of the organ, but Mr. Murray, of the British Museum, has since kindly informed me that it is a wreath of laurel, and should have been carried round the centre of the pedestal. The gem seems to have been intended for the finger, being nearly the length of a finger-joint. It was found to be too narrow to admit of the portrait of the organist by the side of his indispensable organ, if the organ blowers were to have their share of fame, and therefore he has been exhibited in full face above it. It is to be regretted that we cannot ascertain the name of this eminent artist, but even his initials are not to be deciphered. The medal is peculiar in exhibiting the victor in a nude state, but it has this advantage, that we may now admire his ribs and his collar bone, as well as his good-humoured face. So great a celebrity deserves something more than a mere bust.



The two organ blowers have, one the lever up and the other down ; thus to work alternately, and so to diminish the spasmodic injection of the air. The portrait of the before-named victor, Laurentius, may be seen in Dr. William Smith's

Dictionary of Greek and Roman Antiquities, (under *Hydraula*). A third organist, but one looking more like a woman than a man, is exhibited on another coin of Nero, and by the side of that organ is a horn-blower, with a curved horn made of metal, and of the largest size—a very base instrument. The horn is curved over the player's shoulder, and it passes under his arm, to his mouth. A spear crosses the circle described by the horn, and is seemingly there placed for the purpose of steadying the horn.[a]

Tertullian, the most ancient of the Latin Fathers of the Church, and who flourished in and after the end of the second century, compares the soul of man to the Hydraulic Organ. As the soul animates the human body, and acts in every part of it, so does the wind which fills the organ.

"Behold," says he, "the highly portentous and munificent bequest of Archimedes—I mean the Hydraulic Organ. So many members of that body, so many parts, so many joints, so many channels for utterance, such union of different sounds, such interchanges between time, measure, and mode, and so many rows of pipes; yet all together form but one huge pile! So the breath, which there pants by the tossing about of the water, will not be separated into parts, because it is administered through parts; it remains entire in essence though divided in its working."[b]

[a] This is copied into Guhl and Koner's *Das Leben der Griechen und Römer*, 8vo. 1164. p. 241.

[b] "Specta portentosissimam Archimedis munificientiam; organum hydraulicum dico; tot membra, tot partes, tot compagines, tot itinera vocum, tot compendia sonorum, tot commercia modorum, tot acies tibiarum, et una moles erunt omnia. Sic et spiritus qui illic de tormento aquæ anhelat, non ideo separabitur in partes quia per partes administratur, substantia quidem solidus, opera vero divisus."—(*De Anima*, cap. xiv. c. Paris, 1664. fol., p. 273.)

Tertullian was too full of his main subject to think twice as to whether he was ascribing the invention of the Hydraulic Organ to the right person. He stands alone in attributing it to Archimedes. Not only his cotemporary, Athenæus,[a] but also Vitruvius[b] before, and Pliny[c] after his time, unite in ascribing it to Ctesibius, as do all earlier writers.

Three names were given to the sliders of the Hydraulic Organ. First, Herōn describes them as "plinths" to the pipes; next, Vitruvius, as "straight pieces of wood" (*regulæ*); and Publilius Optatianus Porphyrius, a Roman poet of the age of Constantine I., terms them "the square *plectra*." This was, no doubt, from their acting like the plectra of the lyre in exciting sound, although from pipes. The wind itself had a stronger claim to the designation of *plectrum*, in an organ. These changes in the names of sliders have been a puzzle to all commentators.

As I shall not again speak of the plectrum, it is well to notice two Latin idioms, *intus canere*, and *foris canere*. In touching the lyre with the plectrum, the hand was projected outwards, and so away from the lyre. That was *foris canere*. The fingers of the left hand were behind the strings of the lyre, and when they were used in playing, the fingers were *drawn in* towards the palm of the hand and the body of the player. That was *intus canere*. Hence, *intus canere* became proverbial for the action of a petty thief, who would *draw in* anything upon which he could lay his hands, and

[a] Athenæus, lib. iv. cap. 75, p. 174 c.

[b] Vitruvius, lib. ix. cap. 9.

[c] Pliny, lib. vii. cap. 37.

sometimes also for a glutton. Again, thieves were, for a like reason, hinted at as *Aspendii Citharistæ*, because Aspendius was a famous performer on the lyre and cithara, who rejected the use of a plectrum, and played upon all the strings of the cithara with his left hand. Therefore his performances were altogether of the *intus canere* class. Cicero compares Verres to Aspendius in one of his orations,[a] and Asconius comments upon the passage; but it is desirable that the modern reader should know the position of the hands upon the cithara in order to appreciate the two allusions.

The Hydraulic Organ forms the subject of one of the poems of the before-named Publilius Optatianus. For some reason now unknown, he had been banished from Rome; and, in order to be allowed to return, he addressed a panegyric in the form of a set of short poems to the Emperor Constantine I. This flattery was sufficiently acceptable to Constantine to accomplish the object of the poet; and, further, it established him in the Emperor's favour.

Among these poems are three which are respectively entitled "An Altar," "A Syrinx," and "Organon," which is the Hydraulic Organ.

The last is a fanciful composition, which is intended to resemble the form of the organ. Between twenty-six short iambics and twenty-six hexameters a single long line runs vertically, from the top to the bottom of the poem.[b] This may be supposed to represent the edge of the register-board, upon the

[a] "Aspendium citharistam quem omnia intus canere dicebant."—(*In Verrem* i. 20, edit. Amsterdam, 1724. fol., vol. i. p. 290.)

[b] "Augusto victore juvat rata reddere vota."

surface of which the pipes are placed. The twenty-six hexameter lines represent a row of pipes, and each hexameter increases by one letter in each succeeding line, just as the pipes increase in height. The short iambics may be designed for the body of the organ below the register-table. It is difficult to decide whether so, or for back rows of pipes. The pipes are described as of copper or bronze, accompanied by others of reed. The organ is to be so powerful as to be capable of causing the hearers to tremble. The length of the pipes is no further defined than that the smallest is represented by twenty-five letters, and the largest by fifty, thus making twenty-six in a row. The only guess that can be formed as to the length of the pipes is from the allusion to the trembling of the hearers. If the organ could cause a rumbling sensation through the body of the listener, there must have been pipes of at least 16 feet in length, but probably longer. Cassiodorus compares the organ to a tower, and the preceding quotation from Tertullian represents it as a grand pile (*moles*). Optatian speaks of organ-blowers only in the plural number, without specifying the precise number.

So many Roman Emperors admired the tone and the power of the organ that—considering first the public competitions in playing, and secondly the wealth of the empire, coupled with the luxurious extravagances of both emperors and patricians—we may reasonably assume at least the occasional use of the largest pipes from which sound could be produced. There can be but little doubt as to experiments having been made upon the largest scale. In the character of the Roman nobles, by

Ammianus Marcellinus, written about the year 380, and quoted by Gibbon in chapter xxxi., he says:—"But the costly instruments of the theatre, flutes, and enormous lyres and Hydraulic Organs are constructed for their use; and the harmony of vocal and instrumental music is incessantly repeated in the palaces of Rome. In these palaces sound is preferred to sense, and the care of the body to that of the mind."[a]

Having enlarged upon the pith of Optatian's poem, his description of the organ may be transferred to a note.[b] In order to observe his self-imposed task of making each succeeding line to consist of exactly one letter more than the former, Optatian seems to have been driven into writing *quîs* for *queis*, and into spelling *rythmus* instead of *rhythmus*.

It is assumed that M. Danjou was the first of the moderns who counted the letters of Optatian's verses, and so found out their design. Attention was drawn to this fact by my learned friend, the Chevalier E. de Coussemaker, when discussing the difficult subject

[a] Ammianus Marcellinus, cap. vi., edit. Gronovius. Leyden. 1693.

[b] "Hæc erit in varios species aptissima cantus,
Perque modos gradibus surget fecunda sonoris
Ære cavo et tereti, calamis crescentibus aucta,
Quîs bene suppositis quadratis ordine plectris
Artificis manus in numeros clauditque aperitque
Spiramenta, probans placitis bene consona rythmis,
Sub quibus unda latens properantibus incita ventis,
Quos vicibus crebris juvenum labor haud sibi discors
Hinc atque hinc animæque agitant, augetque reluctans,
Compositum ad numeros propriumque ad carmina præstat,
Quodque queat minimum ad motum intremefacta frequenter
Plectra adaperta sequi, aut placidos bene claudere cantus,
Jamque metro et rythmis præstringere quid quid ubique est."
—(Wernsdorf's *Poetæ latini minores*, vol. ii. p. 406: or *Annales Archéologiques* par Didron ainé, vol. iii., 1845, p. 272.)

of the musical instruments of the Middle Ages in the *Annales Archéologiques* of Didron, in and after the year 1844. I cannot follow M. Danjou in his further inference that, because the letters increase in length in each hexameter instead of decreasing, therefore the shortest pipes were on the left of the ancient player, and he must have played the longest pipes, which form the base of the organ, with his right hand instead of his left. There are undoubtedly some representations of organs in that form, but they are overbalanced by others which are not so. On the two medals of Nero's date the one is, and the other is not. An engraver who was not an organ player, but a spectator, would perhaps accustom his eye to the view he had taken when facing the organist, and so would place the long pipes on the right. The "light touch" and the "wandering finger" were far more probably employed upon the smaller and more quickly-speaking pipes than upon the large ones.

Again, an engraver may have thought it a matter of indifference which view he gave of the organ, or he may have forgotten to invert the whole of the design from right to left for a transfer to a seal or to a die.

The poems of Optatian may be dated in or before the year 324, because, in one of the set, he lauds Crispus, the brave and accomplished eldest son of Constantine, who was put to death by his jealous father in that year.

Among the remaining passages from ancient authors which might be quoted as referring to the Hydraulic Organ, I do not observe one which will throw further light upon the construction or the

character of the instrument, and only such are here required. I therefore pass on to the Pneumatic Organ, or organ blown by bellows, more or less after the present manner.

Since the bellows by which the organ was inflated are the distinguishing feature, it may be well to show first how these ancient bellows were worked.

In one of the tombs at Kourna is a painting of an Egyptian smithy;[a] the smith is heating a rod of iron, and his two assistants are blowing the bellows. These are, in every sense, *pairs* of bellows, for the blower has one under each foot. He throws the weight of his body first upon one leg, and then upon the other, drawing up the exhausted bellows at each movement of his body by a string. This mode of

An Egyptian Smithy with the ancient Pairs of Bellows.

action proves that in ancient times bellows were furnished with valves, like those of the present day; for, if otherwise, the exhausted bellows could not have been thus drawn up by the hand. The weight

[a] It is included in the great work of Champollion, plate 165; also in that of Rosellini, and in Wilkinson's *Popular Account of the Ancient Egyptians*, vol. ii., p. 316.

of depressing, and the weight of raising, would have been equal.

If we now turn to Herodotus, we shall find, through an interpretation which the Lacedæmonians gave to an Oracle, that the ancient Arcadians, the most primitive of Greeks, employed bellows of the same character.

The Lacedæmonians had been repeatedly overcome in war by the Tegeans, and therefore sent to the Oracle at Delphi to enquire which of the gods they should propitiate in order to become victorious over the Tegeans.

The *prophētēs*, or priest, who interpreted the Oracle, judging wisely that, as the Lacedæmonians were a brave people and had set their minds upon it, their turn must eventually come, answered that "the Lacedæmonians should become victorious over the Tegeans." It would have been unsafe for the reputation of the Oracle that it should predict a particular date, lest the Tegeans should still be too strong; so the Pythian was reported to have added, "When they had brought back the bones of Orestes, the son of Agamemnon." That was indeed a safe prophecy, for the Lacedæmonians knew absolutely less about the bones of Orestes than we do about the bones of Moses. They could not even tell in what country Orestes had died. If, then, the Lacedæmonians should again be beaten, although they had brought home certain bones which they supposed to be those of Orestes, it would be argued that the Oracle was true, and that the error was altogether on the part of the Lacedæmonians, in having brought home the bones of the wrong person.

A further advantage was to be gained by the

charming vagueness of the reply. It must entail a second consultation of the Oracle; and then the brief was likely to be endorsed with a liberal consultation fee, considering the weight of the cause, the promise of success already made, and the desirability of propitiating the god through his ministers.

All was wisely judged. The Lacedæmonians went a second time to entreat further information. The priests still took care to have plenty of loop-hole, for they alone could interpret the Pythian. They instructed the Lacedæmonians to search for the bones of Orestes in the enemy's country; to

> Seek for them where two winds with strong compulsion are blowing,
> Stroke ever answering stroke, and woe upon woe ever growing.

This lucid exposition gave considerable occupation to Lacedæmonian brains, but luckily there was one sagacious fellow among them, named Lichas. He had heard from a smith, (whether blacksmith or whitesmith is not expressed,) that being about to dig a well by his smithy, in Tegea, he had found there the body of a man of great size, which had been buried upon the spot. This was enough for one so acute in making discoveries as Lichas. He hired the smithy, stole the bones, and carried them off to Sparta. For "seeing the smith's *two* bellows, he discerned in them the *two* winds, and in the anvil and hammer the stroke answering to stroke, and in the iron that was being forged the woe that grew on woe; representing that iron had been invented to the injury of man."[a] Such confidence did he inspire into the Lacedæmonians as to his

[a] Herodotus, *Clio*, cap. 67, 68.

having fulfilled the prophecy, that they were fully convinced they could then beat the Tegeans, and so they did.

And now as to the Roman method of inflation. We may descend to the fourth century of the Christian era, and yet we find the same bellows employed for Pneumatic Organs, according to the sculptures upon the Obelisk of Theodosius. This Obelisk was erected in the Hippodrome at Constantinople, and on its white marble base are three pipers playing upon double pipes, seven dancers, and two Pneumatic Organs, one having larger pipes than the other.

A representation of the entire subject would exceed the width of the present page, and the curious may see it in the *Annales Archéologiques* of Didron for 1845 (p. 277). It is included in one of the learned articles upon musical instruments, more especially those of the Middle Ages, by M. de Coussemaker. The representation is necessarily minute even in the quarto page of Didron; and, since one of the organs is alone required, I have availed myself of the following woodcut of larger size from *The*

History of the Organ by my friends Dr. Rimbault and Mr. E. J. Hopkins, by the kindness of Messrs. R. Cocks & Co.

These two men, or boys, ought to have strings in their hands, and to be standing upon different bellows. All that can be said as to this deficiency is, that the sculptor has not descended to minutiæ. The boys could be of no possible use as they are represented in the engraving.

In point of date the Pneumatic system for the organ is probably long anterior to the Hydraulic. Herōn's work was evidently intended to describe only such inventions as were then recent, or which had some peculiarities not generally understood. For that reason, probably, the only representation of the Pneumatic Organ included in his book is of one with a windmill acting upon the piston of a condensing syringe. Thus it drives air directly into the wind-chest of the organ, without the intermediate action of a condenser. The *pairs* of bellows might not have been worked so easily by a windmill as could a piston, but the organist would only be able to perform upon the windmill-instrument when there was a sufficiently high wind.

The main difficulty in identifying the organ among casual notices of musical instruments by Greek or Roman writers rests upon the wide significations of *organon* and *organum*. The organ may sometimes have been intended, even when the word "syrinx" is used; for Philōn explains an organ to be "a syrinx played by the hands." The four principles of musical pipes were evidently so well understood by the ancients, that it would be strange indeed if

they had not utilised reeds which were too large for the mouth, and too long to be carried about in the hands. Still, we cannot look back for the organ to any barbarous age. A love of harmony, and of hearing several instruments in concert, must have arisen before the organ would have been brought into ordinary use.

The word organ retained its wide application to musical instruments of all classes, down to the times of the fathers of the Christian Church. For instance, St. Augustine says that "all musical instruments are called organa—not merely the organ which is of large dimensions, and which is blown by bellows, but also every kind of instrument upon which a tune can be played, or which may be used for accompanying the voice."[a]

The Emperor Julian wrote an epigram upon the Pneumatic Organ, in which he alludes to its metal pipes and to its leathern bellows. As the epigram is written in the form of an enigma, it is less easy to translate. Dr. Burney,[b] Dr.

[a] "Organa dicuntur omnia instrumenta musicorum. Non solum illud organum dicitur quod grande est et inflatur follibus, sed etiam quidquid aptatur ad cantilenam et corporeum est, quo instrumento utitur qui canat, organum dicitur."—(*Comment. on Psalm*, No. 56.) Augustine has a similar commentary on the 150th Psalm, beginning, "Organum generale nomen est omnium vasorum musicorum," &c.

[b] Dr. Burney (*History*, ii., 65,) translates thus :—"I see reeds of a new species, the growth of another and a brazen soil; such as are not agitated by our winds, but by a blast that rushes from a leathern cavern beneath their roots ; while a robust mortal, running with swift fingers over the concordant keys, makes them, as they smoothly dance, emit melodious sounds." He translates ἀγέρωχος "a tall sturdy fellow," and says, "alluding to the force necessary to beat that kind of clumsy *carillon* keys of this rude instrument of new invention." Dr. Burney had not read Herōn, and expressed his inability to understand Vitruvius, therefore he could know but little about the keys of Greek or Roman organs, and he derived his idea of carillon keys from mediæval writers.

Busby,[a] and others, accomplished it by passing over some of the words, I therefore attempt a more literal version.

"I see reeds, or pipes, of a different kind: I ween that from another, a metallic soil, they have perchance rather sprung up. These are agitated wildly, and not by our breath; but a blast, rushing from within the hollow of a bull's hide, passes underneath, below the foundation of the well-pierced pipes, and a skilled artist, possessed of nimble fingers, regulates by his wandering touch the connecting rods of the pipes, and these rods, softly springing to his touch, express [squeeze out] the song."[b]

There are several words in the above which will bear two constructions, and thus may form an enigma. For instance, *donax* is not only "a reed shaken by the wind," and "a reed pipe," but also "a metal organ pipe." Theodoret uses *calamus* in the last sense, in a comparison included in the third of his *Ten Orations on Providence*, where he says:—"It is like a musical organ which consists of copper or bronze *pipes*, inflated by leather bellows, and which, when

[a] Dr. Busby gives a metrical translation:—

"Reeds I behold, of earth the rigid spoil,
Reeds of a novel growth, and brazen soil!
That not heaven's wind, but blasts mechanic breathe,
From lungs that labour at their roots beneath;
While a skilled artist's nimble finger bounds
O'er dancing keys, and wakes celestial sounds."

—(*History of Music*, vol. i. p. 263.)

[b] "Εἰς ὄργανον μουσικόν.

Ἀλλοίην ὁρόω δονάκων φύσιν· ἦπου ἀπ' ἄλλης
Χαλκείης τάχα μᾶλλον ἀνεβλάστησαν ἀρούρης.
Ἄγριοι, οὐδ' ἀνέμοισιν ὑφ' ἡμετέροις, δονέονται,
Ἀλλ' ἀπὸ ταυρείης προθορὼν σπήλυγγος ἀήτης
Νέρθεν ἐϋτρήτων καλάμων ὑπὸ ῥίζαν ὁδεύει,
Καί τις ἀνὴρ ἀγέρωχος, ἔχων θοὰ δάκτυλα χειρὸς,
Ἵσταται ἀμφαφόων κανόνας συμφράδμονας αὐλῶν·
Οἱ δ' ἁπαλὸν σκιρτῶντες, ἀποθλίβουσιν ἀοιδήν."

—(Brunck's *Analecta*, vol. ii. p. 403.)

played upon by the fingers of a skilled musician, produces that enharmonic reverberation of sound."[a]

Cassiodorus, who was Consul of Rome in 514, retired in the latter part of his life to a monastery of his own founding. He there wrote, among other works, certain *Commentaries on the Psalms*, which he acknowledged to be, in a great measure, derived from the comments of St. Augustine. In his exposition of the 150th Psalm, Cassiodorus thus describes the organ of his day:—"The organ, therefore, is like a tower, made of different pipes, from which, by the blowing of bellows, a most copious sound is secured; and, in order that a suitable modulation may regulate the sounds, it is constructed with certain tongues of wood from the interior, which the fingers of the masters, duly pressing (or forcing back), elicit a full-sounding and most sweet song."[b]

In this last quotation, there is some doubt whether he may not mean an organ with sliders only; for the word *reprimentes* would apply equally to "pressing down" a key and to "forcing back" a slider—which last is the effect produced by pressing a key. We have in this case a Roman, instead of a Greek, writer before us; and one whose date falls within what were once termed the Dark Ages. They were indeed dark as to music. The organ was then falling into disuse in Rome; and, consequently, the art of its construction was soon afterwards lost.

[a] "*Ὀργάνῳ γὰρ ἔοικεν ἀπὸ χαλκῶν συγκειμένῳ καλάμων, καὶ ὑπ᾽ ἀσκῶν ἐκφυσουμένῳ, καὶ κινουμένῳ ὑπὸ τῶν τοῦ τεχνίτου δακτύλων, καὶ ἀποτελοῦντι τὴν ἐναρμόνιον ἐκείνην ἠχὴν.*"—(Migne's *Patrologia Græca*, Theodoret, vol. iv. p. 590.)

[b] Organum itaque est quasi turris, diversis fistulis fabricata, quibus flatu follium vox copiosissima destinatur; et, ut eam modulatio decora componat, linguis quibusdam ligneis ab interiore parte construitur, quas disciplinabiliter magistrorum digiti reprimentes, grandisonam efficiunt et suavissimam cantilenam.

It is from passages of this indefinite class, and from descriptions of rudely constructed instruments of later date, that the employment of keys in ancient organs has been doubted. Cassiodorus speaks of organists in the plural number; two would, indeed, be required if the organ had but sliders. On the other hand, he refers to playing it with the fingers, and not with the entire hand, therefore it is still to be assumed that the organ was provided with keys. If the instrument had sliders, and no keys to command them, either the entire hand or the forefinger and thumb would be used, and not merely the fingers.

The last notable point in the quotation from Cassiodorus is, that the sounds produced by the organists are not termed harmony (*concentum*), but simply an air (*cantilenam*). This may be because he sums up the whole effect as one; but, if to be taken literally, how greatly must the art of organ-playing have declined in the early part of the sixth century, supposing two persons to have been required to play the treble and base of an air! The doubts of our earlier historians as to Greek and Roman organs having been furnished with keys are to be accounted for by their not having known the *Pneumatika* of Herōn. Neither Dr. Burney nor Sir John Hawkins refers to Herōn's work in their Histories, nor would they expect to find a description of the Hydraulic Organ in a work professedly on Pneumatics. Each, therefore, required better *data* to enable him to form a sound judgment.

Having now brought down an account of the organ from its earliest known date to the sixth century, its future history will pass through the ordeal of a

second infancy of music, in the Middle Ages, before that noble instrument can emerge in its full powers. The obscurity which reigned in those ages was originally and mainly due to the indifference which had so long characterized the Romans as to arts and sciences which would neither tend to their pecuniary advantage, nor assist them to an advance in the State. Neither in the times of Roman "virtue," nor in those after times of luxury and self-indulgence, do we find symptoms of that earnest desire for knowledge which was characteristic of the ancient Greeks. It would be vain to search for a Socrates, a Plato, an Aristotle, a Didymus, or even a Claudius Ptolemy, among Romans. Bunsen has said, rather severely, that "the divine thirst for knowledge for its own sake, or for truth from a love of truth, never disturbed a Roman mind."—(*Egypt*, i. 166.)

After they had conquered the Greeks, the Romans embellished their own language by so large an importation of Greek words, as to form no inconsiderable part of a modern Latin dictionary; but partly from inattention, and partly from insufficient knowledge of the Greek tongue, they so misapplied many of the words, as to cause the greatest perplexity to such after-enquirers as have sought to learn Greek arts through the medium of Latin interpretations.

This was especially the case in music, but the misapplication of Greek terms extended far beyond that greatest of arts. Even in architecture, upon which the Romans especially prided themselves, indifference as to the preservation of right meanings of words was equally manifest. Vitruvius comments upon some of these misapplied terms in his book upon

Architecture;[a] but, like a true Roman, not from any desire to see them restored to their proper places, but simply to explain the words for the benefit of philologists.[b]

Unhappily, there was no Vitruvius to explain to us the misappropriation of Greek terms in music, and, consequently, they have remained, to this time, the great stumbling-block to an intelligent appreciation of the Greek system.

Further than this, Western Europe was taught through the Latin medium that there are but three accents (*prosōdiai*) in the Greek language.[c] Discussions have consequently been carried on for more than a century, and many of the ablest scholars in Europe have taken part in them, to decide whether Greek accents have that quantity in them which characterizes the accents of modern Europe, or whether they have not. Each side, indeed, might claim to have been right, according to its different acceptation of the word "accents" or *prosōdiai;* for,

[a] 5. Inter duo autem *peristylia* itinera sunt quæ *mesaulæ* dicuntur, quod inter duas *aulas* media sunt interposita; nostri autem eas *andronas* appellant. Sed hoc valde est mirandum, nec enim græce nec latine potest convenire. Græci enim *andronas* appellant *oecos*, ubi convivia virilia solent esse, quod eo mulieres non accedunt. Item aliæ res sunt similes, uti *xystus*, *prothyrum*, *telamones*, et nonnulla alia ejusmodi; *xustos* enim græca appellatione est porticus ampla latitudine, in qua *athletae* per hiberna tempora exercentur. Nostri autem *hypaethras* ambulationes *xysta* appellant, quas Græci *paradromidas* dicunt. Item *prothyra* græce dicuntur, quæ sunt ante januas vestibula; nos autem appellamus *prothyra* quæ græce dicuntur *diathura*. 6. Item si qua virili figura signa *mutulos* aut *coronas* sustinent, nostri *telamones* appellant; cujus rationes, quid ita aut quare dicuntur, ex *historiis* non inveniuntur. Græci vero eas *atlantas* vocitant."—(*Lib.* vi. cap. 7, *vulgo* 10.)

[b] 7. Nec tamen ego ut mutetur consuetudo nominationum aut sermonis; sed ut ea non sint ignota philologis exponenda judicavi.—(*Ibid.*)

[c] It remained so in the Eton *Greek Grammar* of 1819, from which I began to learn. All boys were then taught Greek through Latin.

while the acute and the grave accents have neither stress nor quantity assigned to them by any ancient Greek author, there are other *prosōdiai* which have quantity. Again, there is one for hard breathing, therefore it involves the stress which has been claimed for them.

Ancient authorities define accents as of three kinds; the first, for the pitch of the sound; the second, for its duration; and the third, for the hard or soft breathing of vowels and consonants. The three which are for pitch are the acute,[a] the grave, and the circumflex accents; the two for time are identical with those which are still used in prosody to mark long and short syllables (- ᴗ); and the two for the management of the breath are the well-known signs which are placed over Greek vowels, to denote hard or soft breathings.[b] Some writers, indeed, add

[a] Take the word ἄνθρωπος. The *a* is the highest vowel, and it has the mark of the acute accent, it is therefore to be pronounced naturally, as if there were no accent at all. It may seem then to be superfluous to the moderns; but in the genitive case, ἀνθρώπου, the voice is to be thrown up on the second syllable. Thus the accent becomes a pronunciation mark, very easily exercised upon long vowels, but requiring more care in the case of short ones. Mr. Hullah ranks the ascent of our vowels, if with continental pronunciation, and with the open sound of O, as U, O, A, E, I, in ascending, and as I, E, A, O, U, in descending. High vowels are produced from the back, and the low vowels from the front of the mouth; the lowest sounds require the lips to be elongated. The circumflex, or *perispōmenē*, is necessarily long, because it commands both a rise and a fall in the voice, something like its semicircular form. Dionysius speaks of it as a twisting round of the voice, ἡ κατὰ περίκλασιν ἐν τῇ περισπωμένῃ. The grave accent signifies only the equalization or levelling of tone, κατὰ ὁμαλισμὸν ἐν τῇ βαρείᾳ. Both the acute and the grave accents are included among musical signs, sometimes over letters, and sometimes standing alone. See *Alypius*, pages 4, 6, 7, 8, 56, &c., in Meibom's edit.

[b] The following is the whole passage relating to *prosōdia*. It commences with accentuation by the mouth into the flute; and next on the positions of accents; but only the last part of the paragraph is referred to in the text above:—Ἰστέον ὅτι τριχῶς λέγεται ἡ προσῳδία καὶ (γὰρ) ἡ παρὰ τοῖς μουσικοῖς, τουτέστι τὸ στόμα καὶ ἡ ἐκφώνησις τῶν

three more to the above seven, viz., the apostrophe, the hyphen, and the short stop called *hypodiastolē*, but no marks, which were on the same level or under the words, are generally admitted among *prosōdiai.*

Prosōdiai were signs to guide the voice in recitation of all kinds, and out of those accents grew the systems of ecclesiastical notation, called *pneumata*—guides for the management of the breath, now called neumes. These are abundantly exhibited in manuscripts of the Eastern, and of the early Western, Churches; but the two divisions worked out their systems differently. Neumes did not originally designate any definite notes or pitch, because musical intervals were not required in recitation. If any fixed musical sounds had been designed, letters over the words would necessarily have been employed, as in Greek music, instead of such indefinite marks.

In the course of after-ages, some of the scribes attached to the Western Church drew faint lines through each row of the neumes with a plummet, while others painted coloured lines through them, first one, and afterwards two lines—red and saffron. These were to guide as to the starting notes of the chants, and as to the degrees of ascent or descent for the voice. Thus the present musical notation by lines and spaces had its origin. Square and round notes, to mark time, are of later date.

αὐλῶν, λέγεται προσῳδία· καὶ ἡ ἐν τῇ ἐκφωνήσει γινομένη, τουτέστιν ἐν τῷ παροξύνεσθαι λέξιν ἢ ὀξύνεσθαι ἢ περισπᾶσθαι· καὶ αὐτὸς ὁ χαρακτὴρ τῶν τόνων, καὶ τῶν χρόνων, καὶ τῶν πνευμάτων, οἷον ὀξεῖα, βαρεῖα, περισπωμένη. Ταῦτα μὲν ἐν τούτοις. Ἰστέον δὲ ὅτι ἐν ταῖς προσῳδίαις τρία ἐστὶν εἴδη· ἔστι γὰρ τόνος, χρόνος, πνεῦμα· καὶ τόνοι μέν εἰσι τρεῖς, ὀξεῖα, βαρεῖα, περισπωμένη· χρόνοι δύο, μακρὰ καὶ βραχεῖα· πνεύματα δύο, δασεῖα καὶ ψιλή. Ἑπτὰ οὖν εἰσὶν, ὡς δέδεικται, αἱ προσῳδίαι. (Immanuel Bekker's *Anecdota Græca*, p. 706. See also p. 674 the *Σχολία εἰς τὴν Διονύσιου γραμματικήν*, and Porphyrius *Περὶ προσῳδίας*.)

The word *accentus*, from which we derive *accent*, is compounded of *ad* and *cantus*, which is a translation of the Greek *pros ōdē*. Length of syllable is therefore quite as much a part of accent, or *prosōdia*, as the elevation or depression of the voice. The Latin word *cantus*, like the Greek *ōdē*, includes all recitation of verse, and all irregular chanting, as well as that which is governed by strictly musical intervals.

It is commonly reputed that Aristophanes of Byzantium "invented" the marks for Greek accents. This rests upon the supposed authority of Arcadius of Antioch, who is said to have lived at some uncertain date after the completion of the second century of our era. But as Aristophanes flourished in the third century before Christ, the uncorroborated evidence of Arcadius is insufficient to establish an event 500 years before his own time. Moreover, his account is irreconcilable with passages referring to accents in the works of ancient authors, such as the one I have already quoted from Aristoxenus (p. 89, note *a*). Aristoxenus flourished a century before Aristophanes of Byzantium. Again, recitation of the Homeric poems had been an especial subject for competition in the public games of Greece from the far earlier date of Terpander; and the copies of these poems are said to have been irregular in metre until they received the polish of the Alexandrian grammarians. Aristophanes was one of the most eminent of those grammarians. Irregularities in the Homeric poems were excused, because they had been written for chanting. The very irregularities made those simplest of marks (which required no genius to invent) almost indispensable for the study of the rhapsodists. It is then by far more probable that

Aristophanes marked the accents afresh, after he had polished the poems, and had thus made certain changes necessary, than that he was the first inventor of those essential guides to rhapsodists. It should not be forgotten that poems thus chanted are the most ancient of all Greek literature.

The passage in which the first employment of Greek *prosōdiai* or accents of the three kinds is attributed to Aristophanes of Byzantium is more probably the production of some later commentator than Arcadius of Antioch. Judging by the Leipzig edition of 1820,[a] it is not included in the acknowledged work of Arcadius upon the subject of accents; and the sole authority for attributing it to him seems to be a very indifferent manuscript in the Imperial, or National, Library in Paris.[b] Another *codex* in the same collection includes this panegyric upon Aristophanes in the Grammar of Theodosius of Alexandria (who was himself one of the commentators upon Dionysius of Thrace); while the best of all the manuscripts, the one of highest authority, which is in the Library at Copenhagen, omits it altogether.

It is, however, quite unimportant, even if written by one or other of these late grammarians; for, when opposed to conflicting evidence of much earlier date, and examined by the light of reason, the originality

[a] Arcadius *De Accentibus* (περὶ τόνων, which includes περὶ προσῳδιῶν), edited by Edmund Henry Barker. Leipzig. 1820. 8vo.

[b] *Aristophanis Byzantii Grammatici Alexandrini Fragmenta*, by Augustus Nauck (Halis, 1848. 8vo), p. 12:—"Num sit Arcadii, cui vulgo tribuitur, fateor me dubitare; etenim Arcadio in solo adhæret codice (Paris, No. 2, 102), libro vilissimo. Codex No. 2, 603 eandem expositionem in Theodosiana grammatica exhibet: omnino ignorat liber Havniensis, longe præstantissimus." Again, at p. 16:—"In Homericis carminibus jam Zenodotum quibusdam signis usum fuisse testatur, præter alios, Gram. Bekk. Schol. Iliados, p. iii."

of Aristophanes becomes incredible. While so much thought was given to the art of writing down music in the age of Aristoxenus, that he complained of the too great attention paid to it, as being mere mechanism instead of art, is it probable that the declamation of the Homeric poems and others, the staple music for the lyres of few strings, can have been altogether without its kindred notation? To what other can Aristoxenus refer when he writes of the *prosōdiai* which accompany diction?

Upon this point it may be broadly stated that all the reciters of epic poetry, and all those who used lyres of four, five, and six strings, were mere rhapsodists, or chanters;[a] and that Greek music, in our sense of the word, began with the Anacreons, Sapphos, and others, who sang lyric poetry, and employed the many-stringed Asiatic lyres to accompany the voice.

The limit to the fluctuations of the voice in discourse was fixed by Dionysius of Halicarnassus, as within the musical interval of a Fifth.[b] Any discussion, which would fluctuate even so widely, would appear energetic to men of our northern extraction. It was probably not greater than a Fifth in those ancient recitations, although they were carried on at a higher pitch than the conversational tone of voice, for the sake of superior audibility.

[a] It appears that when rhapsodists made their chants without holding musical instruments in their hands, they took a branch of laurel while reciting the poems of Homer, and one of myrtle when reciting from Æschylus. See Scholiast on lines 1364-5 (Dindorf's edit.) of the Nubes of Aristophanes: — *ἀλλὰ μυρρίνην λαβόντα τῶν Αἰσχύλου λέξαι τί μοι.* See also the Commentary of Eustathius on the Iliad, Book i., beginning: —*Ὅτι δὲ καὶ παρὰ τὴν ῥάβδον, ἡ ῥαψῳδία εἴρηται.*—(p. 6, Leipzig edit., 1827.)

[b] *De Compositione Verborum,* p. 34, Tauchnitz's edit.

Having commented upon the indifference shown by the Romans as to whether they did or did not misapply Greek words, it should be added that, among the moderns, there have been instances of a like indifference as to the texts of Roman authors, at least, upon the rhythmical arts. Not a little carelessness has been exhibited occasionally where it would be least expected. A writer so pre-eminent as Cicero had strong claims to careful treatment from his editors; but even his works have not yet obtained their full meed of attention. Suppose, for example, we take Cicero's Treatises on Oratory, which form the second volume of his works, as re-edited by an eminent scholar, one whose edition has been recently stereotyped.[a] Cicero is still misrepresented as having said that "the rhythmical foot is divided *into three parts*."[b] Anything so manifestly incorrect must grate upon the ear of every thinking reader. How could the two equal syllables of a spondee be divided into three parts? If any one of the numerous antecedent editors would but have put that question to himself, he would surely have been led to consider the context, in order to arrive at the author's meaning. Then he would have found unequivocal proof that Cicero did not assert that a foot in rhythm is divisible "into three parts," but that it may be divided "in three ways." In

[a] M. Tullii Ciceronis *Opera Omnia* . . . iterum edidit Car. Frid. Aug. Nobbe, Prof. Lips. et Gymnasii Nicol. Rector. Nova editio stereotypa C. Tauchniana, Tom. 2. Nova impressio. Lipsiæ, 1867.

[b] "Pes enim qui adhibetur ad numeros partitur in tria" [instead of "*in tria*," it should be "*tribus modis*"] "ut necesse sit partem pedis aut æqualem alteri parti, aut altero tanto" [for "aut altero tanto," read "aut altero *tanto plus*"] "aut sesqui esse majorem. Ita fit æqualis dactylus, duplex iambus, sesquiplex paeon."—(Cicero, 11 *Orator*, cap. 56, No. 188.)

the ensuing lines of the text the three ways are exemplified.

(1), "Either the one part of the foot must be equal to the other; or,

(2), "It must be double the length of the other; or else,

(3), "The one must be in the proportion of three to two of the other."

The editors were possibly confused by a second error in the incorrect old text, although this second is quite as palpable as the first. The word "plus" has been omitted, and thus the first and second ways are represented as identical. For the first mode of division is, "one part *equal* to the other;" and the second is said in the text to be, "one part *as much as* the other;" instead of "as *much more than* the other."

In doubtful cases it would have been necessary to refer to manuscripts, but corrections such as these are self-evident. Cicero continues the illustration by examples which are familiar to all.

For the first mode, or the equal division of parts, he cites the dactyl, of which the first syllable is long, and the second and third, being both short, are *equal* to one long. His second example is the iambus, of which the first syllable is short, and the second long; therefore the second is *double* the length of the first. His third example is the paeon, and this is of two principal kinds. The first kind commences with a long syllable, followed by three short ones, as *dēsĭnĭtĕ, īncĭpĭtĕ, cōmprĭmĭtĕ;* and the second kind commences with the three short, and

ends with the one long syllable, as *dŏmŭĕrānt,* and *sŏnĭpĕdēs.*[a]

One long is equal to two breves, in syllables as well as in music, so that either kind of paeon is sesquialteral, or in the proportion of 3 to 2 in its parts. The paeon, says Cicero, is unsuitable for poetry, and is therefore the better adapted for oratory, since oratory ought not to sound like verse.[b] Nevertheless, there should be a perceptible rhythm in all oratory,[c] as in good prose-writing. In these cases the rhythm is constituted by a judicious intermixture of short with long syllables, and of short with long words, so that each sentence may seem to flow from the tongue. Its divisions are then marked by the rise and fall of the voice, by emphasis, and by pause or punctuation.

Now, as to the word *sesqui,* which occurs in the quotation from Cicero. It is of constant employment in music, and some have supposed it to be an abbreviation of *semisque,*[d] because a *sesquilibra* equals in quantity a pound and a half, and a *sesquicyathus* a cup and a half. But this coincidence occurs only in certain cases, for the translation "half" will not hold good when *sesqui* is prefixed to any number greater than 2. Its quantity diminishes as the number rises, for it is but the unit above its accompanying number. Our musical consonances are generally in the ratio of the unit above; and *sesqui*

[a] Cicero, 9 *De Oratore,* lib. iii., cap. 47, No. 183.

[b] Pæon autem minime est aptus ad versum; quo libentius eum recipit oratio.—(11 *Orator,* cap. 57, No. 194.) Effugimus tamen in Oratione poematis similitudinem. (11 *Orator,* cap. 59, No. 201.)

[c] Ergo esse in oratione numerum quemdam non est difficile cognoscere; judicat enim sensus . . . sed in versibus res est apertior.—(11 *Orator,* cap. 55, No. 183.)

[d] That will not account for a change of *que* into *qui.*

is used to designate them according to their proportions. Thus the *sesquialter* proportion is of 3 to 2, and it represents the musical interval of a Fifth; *sesquitertius* is the proportion of 4 to 3, and is therefore equal to the musical interval of a Fourth; while the *sesquioctava* is the proportion which 9 bears to 8, and so represents the musical interval of a major tone.

The Octave, being 2 to 1, is not a *sesqui*, but a *duplex*. Therefore the principal *sesqui*, the one of largest proportions, and of lowest numbers, is 3 to 2, or the unit above 2. Perhaps, for this reason, 3 to 2 may have been adopted as the meaning of the word when coupled with quantity, instead of with number; and in this way only can the proportions of the *sesquilibra* and the *sesquicyathus* be consistently accounted for. The Greeks had two different words to distinguish the proportions. If so large as 3 to 2, it was *hēmiolios*, and *epi* was employed for all numbers higher than 2, and then signified the unit above the number specified. By dividing the one pound into two parts, and adding another such part, the quantity becomes a pound and a half.

Some Orientalist may yet inform us from what language *sesqui* is derived; but, in the meantime, it may be observed that, in music, it is equivalent to the Greek *epi* if the number to which it is prefixed be higher than 2, and to the Latin *super*. For instance, the Greek word *epitritos* can only be translated into Latin by *sesquitertius*, or *supertertius*, and in English it must be rendered, "the proportion of 4 to 3, or the interval of a Fourth."

In the opening chapter of this volume it was

stated that Cicero frequently paraphrased Aristotle, and that Quintilian did the like by Cicero. It is well then to observe that the passage just quoted from Cicero is one of those which owe their parentage to Aristotle, and is likewise one which was borrowed from Cicero by Quintilian. The original will be found in Aristotle's *Treatise on Rhetoric*,[a] and the third in order is in Quintilian's work on Oratory.[b] The two are subjoined in foot-notes, to facilitate comparison.

The extract from Quintilian affords, unluckily, two other cases of editorial remissness; but the original fault is probably chargeable upon the transcriber's incompetence to decipher old manuscripts. The words *sescuplex* and *sescuplum* are evidently copyist's blunders; the first should be *sesquiplex* (equivalent to *sesquiplus*), and the second should be *sesquiplicem.* Judging from other errors in the text of Quintilian, we may form our opinion as to how these two have occurred. The letter *q* is often used in manuscripts as an abbreviation for *qui,* and the copyist probably mistook the writing of a short-tailed *q* for "cu." Then *plicem* would also be abbreviated, after the letter *l,* and the copyist,

[a] Ἔστι δὲ τρίτος ὁ παιάν, καὶ ἐχόμενος τῶν εἰρημένων· τρία γὰρ πρὸς δύο ἐστίν, ἐκείνων δὲ ὁ μὲν ἓν πρὸς ἕν, ὁ δὲ δύο πρὸς ἓν· ἔχεται δὲ τῶν λόγων τούτων ὁ ἡμιόλιος· οὗτος δ'ἐστὶν ὁ παιάν. (Aristotle *De Rhetorica,* lib iii., cap. 8.)

[b] "Est quidem vis eadem et aliis pedibus, sed nomen illud tenet:—Longam esse duorum temporum, Brevem unius, etiam pueri sciunt—aut sescuplex" [read "sesquiplex," on the authority of Aristotle and of Cicero, from whom Quintilian is copying] "ut paeon, quum sit ex Longa et tribus Brevibus, quique ei contrarius, ex tribus Brevibus et Longa; vel alio quoque modo ut tempora tria ad duo relata sescuplum faciunt:" [read "sesquiplicem faciunt," for "sescuplus" gives a wrong sense—viz., "sixfold," instead of "three to two"] "aut duplex, ut iambus (nam est ex Brevi et Longa), quique est ei contrarius" [meaning a trochee].—(Quintilian, *Inst. Orator.*, lib. 9, 4, 47.)

understanding neither abbreviations nor the subject of the book, converted *plicem* into *plum.* This seems to be the only reasonable explanation of his having changed the proportion of "three to two" into "sixfold."[a] The texts of the three authors establish one another.

A few words may be added as to the English pronunciation of Latin in singing. More than two hundred years ago Milton wrote, in his *Tractate on Education*, that "to smatter Latin with an English mouth is as ill hearing as Law French." We have therefore had ample time to think about it, and we are beginning to act. The excuse for not having done so before is this:—

The pronunciation of Latin in the English fashion was not only allowed, but encouraged, after the Reformation; for by that test a scholar bred up in England could be distinguished from one educated at a foreign university. It thus became a trap to catch a Jesuit. But since toleration has been extended to all religious creeds by the good sense of the English Government, the motive for mispronouncing Latin has passed away.

No manner of speaking the language could be more devoid of authority than the English. In our native tongue we have twisted the vowels round upon the wheel until we have made the soft *a* to take the place of *e*, our *e* to take the place of *i*, and *i* and *y* to have commonly the same sound. To this there are, of course, exceptions, as there are to all rules of pronunciation in the English language; but

[a] The progression is *duplus, triplus, quadruplus, quincuplus, sescuplus, septuplus*, &c. See, for instance, Boethius on Arithmetic, lib. 1., cap. 23, lines 23 *et seq.*

such has been the general system of speaking Latin by Englishmen. It has neither the warranty of our own more ancient language, of Northern English, of Scotch, of Irish, nor of any European tongue, except our own.

Before quitting the field of ancient history to turn to that of the middle ages, there is one instrument much referred to, and described by early Latin commentators on the Psalms, and although its name is of Greek derivation, it does not correspond with the Greek instrument.

A Greek psaltery has already been exhibited, at p. 308, where it is in the hands of Erato; and both the name of the muse and of the instrument are inscribed on the pedestal of the statue. It is there of quadrilateral form, whereas the psalteries described by Cassiodorus and by others are triangular, and must therefore be more nearly represented by the Greek and Etruscan Trigons, or by the Assyrian Harp. The last especially had the sounding body above instead of below the strings. The accompanying figure is copied from one of the sculptured marble slabs which were

Assyrian Harper, 7th century B.C., from a sculpture in the British Museum.

taken from the palace of Konyunjik, Nineveh, and are now in the British Museum. It represents an Assyrian musician attending upon the King Asshur-Bani-Pal in his garden. The reign of this king is known to have been from B.C. 667 to 647. The form of the harp and its sound-holes is better developed in this sculpture than in others which represent the triumph of the same king over the Susians, and which are also in the British Museum. Here, too, the bow shape of the back of the instrument is well defined.

Cassiodorus describes the psaltery as having its sounding body above the strings, as in this example, and he contrasts it with the harp, which has its hollow wood for emitting sound situated below the strings.[a]

Within a century after the death of Cassiodorus, Isidore of Seville, the young friend of Pope Gregory the Great, describes the Psaltery as in the form of the Greek letter Delta, Δ. Isidore was made a Bishop in 601, and died in 636. The Assyrian harp would make but an indifferent Delta, on account of its rounded back, and its want of a third side to complete the triangle. So Isidore can only allude to another form of psaltery, of which examples will be shown in the sequel. When we descend still lower in the scale of time, we shall meet with descriptions of this instrument as one which in shape resembles a four-cornered shield. Thus it resumes the form of

[a] Psalterium vero est in modum citharæ conversa positio. Buccas enim quasdam sonoras ligni gestat in capite: ubi ab imo venientes chordarum sonos in altum rapit, et ratissima, quantum dicitur, modulatione respondet. Cithara enim ligni quodam ventre inferius constituto, a summo chordarum filis venientibus sonos recipit, atque in unam gratiam jucunditatis mittit. (In Psal. 150.)

the Greek model. The psalteries of the middle ages were therefore of different kinds, and agreed only in being of the harp class. They had no finger boards to press the strings against, and so to make one string produce many notes, but they were played with the fingers, like the harp, and derived their general name from being used to accompany the voice in psalmody.

Another beautiful sculpture in the British Museum deserves reproduction here, as an example of an ancient flute, with an unusual mouthpiece. At one time the flute was taught to all high-born Greeks, but Alcibiades drove it out of fashion, because he

thought it disfigured the beauty of his mouth.[a] That objection once raised was found too serious an obstacle to the continuance of its use by any other

[a] This account of Alcibiades is quoted *in extenso* by Aulus Gellius from the 29th Commentary of Pamphila. See *Noctes Atticae*, lib. xv., cap. 17, 1.

young Athenian of fashion. In the example before us, the instrument itself is removed from immediate contact with the lips, by the mouthpiece, and thus the entire face of the flute player is rendered visible. The position of the hands is admirably suggestive of the act of playing.

The original is a marble terminal statue from the Cività Lavinia, the ancient Lanuvium. It has been guessed to be a representation of Comus.

Roman orators had sometimes a flute player or piper behind them to give them the pitch for their orations. At least, one such instance is mentioned by Cicero, by Plutarch, and by Quintilian. It is of the celebrated orator, Caius Gracchus, whose "splendid and persuasive" eloquence for a long time carried all before him in Rome. He had a servant, named Licinius, who stood at his back when Caius spoke in public; and this Licinius being, as Plutarch says, "a sensible man," judged when the orator was straining his voice to too high a pitch, and would then sound a lower note, in order to bring it down; and when, on the contrary, Caius had adopted too low a tone, Licinius would sound a higher note, in order to indicate that he should raise his voice to that pitch. The pitchpipe, according to Cicero, was of ivory; and, as Quintilian gives it the Greek name of *tonarion*, we may suppose instruments of the same kind to have been used by Greeks.

It cannot be doubted that orators used a certain amount of chanting or intonation in their addresses; and hence they are commonly represented in sculpture and in paintings with musical instruments beside them—usually a lyre resting on the left arm. It would, indeed, be difficult now to ascertain the ex-

tent to which this kind of sing-song was carried; but it is evident from the books on oratory, including the admirable work of Dionysius of Halicarnassus, *De Compositione Verborum,* that the tones of the voice formed a complete study, both for recitations and for harangues,[a] as well as for what is more strictly music, in our sense of the word.

Melodia, in Greek, and *cantus,* in Latin, apply equally to inflexions of the voice in prose and in verse; indeed, *cantus* is sometimes employed when neither musical intervals nor agreeable sounds were intended, as in the *cantus galli,* or crowing of the cock; unless, indeed, we are to suppose the ancient cock to have had a more melodious voice than his descendants.

The *Cantus,* or Chanting of the Christian Church, and its variations in different ages, as well as the differences of practice between the Eastern and Western branches of the Church, are subjects for a future volume; but before that division took place, and before the so-called "antiphonal singing" had been introduced, the chanting in the churches of Alexandria seems to have been identical with Greek rhapsodizing.

Materials for the history of those times are by no means abundant, but this inference may be drawn from an incidental notice in St. Augustine's *Confessions.* It is, however, necessary to preface the passage by his account of his own preferences, in order to show the force of the context.

St. Augustine expresses his delight in hearing the Psalms chanted according to musical modes, or

[a] This valuable treatise would furnish many quotations to the point. It is, perhaps, sufficient here to cite one line :—*μουσική γὰρ τις ἦν καὶ ἡ τῶν πολιτικῶν λόγων ἐπιστήμη,* &c.—p. 34.—(Tauchnitz's edition, vol. v., cap. 11.)

scales, having the accompaniment of a musical instrument, to regulate and to guide the voice. His experience had told him that Psalms thus sung had a far greater effect upon his own mind than by any other means, although he felt at the time unable to explain the "hidden cause."[a]

The cause, although hidden at the time from St. Augustine, may be traced with very little difficulty. It was simply that he had taken advantage of opportunities to cultivate his ears. That cultivation was afterwards evinced by his writing a treatise upon music and upon rhythm, in six books, which are still extant. He had therefore learnt how much more forcibly the sacred words are expressed with the aid of music than by any mere reading or recitation.

Augustine tells us that sometimes he hesitated whether, after all, he might not have been deriving something of earthly pleasure from his sacred music;[b] and, in one of those moods, he contrasted with his own practice that of St. Athanasius, when Bishop of Alexandria, of whose precepts he had often heard.

St. Athanasius directed the readers of the Psalms in churches to use "such moderate inflexions of the voice, that it approached more nearly to speaking than to singing."[c]

If, then, the Psalms were not sung according to

Dum ipsis sanctis dictis religiosius et ardentius sentio moveri animos nostros in flammam pietatis cum ita cantantur quam si non ita cantarentur; et omnes adfectus spiritus nostri, pro sui diversitate, habere proprios modos in voce atque cantu, quorum nescio qua occulta familiaritate excitentur. —(*Confessionum*, lib. x., cap. 33.)

[b] Ita fluctuo inter periculum voluptatis et experimentum salubritatis.—(Lib. 10, cap. 33.)

[c] Aliquando . . . tutiusque mihi videtur, quod de Alexandrino episcopo Athanasio sæpe mihi dictum commemini, qui tam modico flexu vocis faciebat sonare lectorem psalmi, ut pronuntianti vicinior esset quam canenti.—(*Confessionum*, lib. x., cap. 33.)

musical modes or scales in Alexandria during the pontificate of Athanasius, there remained no other way than by those indefinite sounds which the Greeks termed natural music or unrestricted rhapsodizing, and which an Eastern now employs while reading the Kŏrān.

Having recently been indulged with a hearing of this last kind, I can but say that it reminded me forcibly of the saying of C. Cæsar the Roman orator, about 80 years B.C., "If you are singing, you sing badly; and if you are reading, you sing."[a] This kind of chanting appeared to me like a series of attempts at musical intervals, every one of which was sung out of tune.

Before closing this branch of the subject, some reader may wish to know why, after having brought down the history to the age of St. Augustine, no notice has been taken of what is termed "Ambrosian music." The answer is, that Ambrosian music is not of so early a time. The two systems, Ambrosian and Gregorian, did not exist at the dates of their now-supposed founders. The meaning of "Ambrosian music" is "music according to the use of Milan;" and of "Gregorian music," "according to the use of Rome." *Nos Gregoriani*, "we who follow the use of Rome;" and *Nos Ambrosiani*, "we who follow the use of Milan"—Ambrose and Gregory having been the founders of the two churches.

And now, *laus Deo*, I bid farewell to ancient Egyptians, Chaldæans, Greeks, and Romans; ending with an Egyptian caricature of a quartet concert at the Court of Rameses III. The King himself is the

[a] Si cantas, male cantas; si legis, cantas.—(Quintilian, *De Instit. Oratoria*, lib. i., cap. 8, art. 2.)

Caricature of an Egyptian Quartet Concert, in the reign of Rameses III. From the Turin Satiric Papyrus.

royal lion playing upon the lyre; one of his courtiers is satirized as a crocodile playing upon a lute; a second as a long-tailed animal playing upon double pipes; while the third is represented as an ass, or a mule, with exceedingly long ears, playing a base upon the harp, to the treble of the King's lyre. The characters thus satirized cannot now be judged, through our not knowing the men; but the lion is clearly intended for Rameses III. In another satirical drawing in the papyrus, from which the above is derived, Rameses, as the lion, is playing a game like chess or draughts with a gazelle in the hăreem.

A short volume, like this, does not show the amount of investigation its manifold subjects have required —sometimes in art, sometimes in science, and sometimes in language. Music is indeed a wide theme to write upon, owing to the universality of its language. The minds and feelings of all nations have been more or less influenced by it in all ages, according to the degrees in which they have cultivated it. A divine origin has been attributed to music, on account of its originality, its universally beneficial tendency, and its innocence, even when cultivated to excess. No other art or science has so cheered the spirits of man and so relieved a wearied mind as music. As to beneficial operation it leaves all other arts at a distance. Justly did a Greek author say, "Music is a great and lasting pleasure to all who have learnt it and know anything about it."[a]

[a] Μέγας γὰρ θησαυρός ἐστι καὶ βέβαιος ἡ μουσικὴ ἅπασι τοῖς μαθοῦσι παιδευθεῖσί τε.—(Athenæus, xiv., 18.)

ERRATA AND ADDENDA.

Page 6, line 6. For "of 8 to 3," read "*nominally* of 8 to 3."

Page 18, last line but five. For "*more than* a century," read "*in the third* century."

Page 21, last line but one of note. For "searched *for*," read "searched *to produce*."

Page 36, note [b], line 1. "Of the *ancients*" refers to all except the followers of Claudius Ptolemy.

Page 52, line 2. After "Olympus," add "*is the same which*."

Page 52, line 1 of note. Delete the *iota subscriptum* to ὥραι.

Page 53, line 17. For "takes away *nothing less than*," read "*artlessly* takes away."

Page 54. The use of lyre and pipe by the Romans in supplications to the gods might have been added to that of the Egyptians and the Greeks. Nec tibicen omnibus supplicationibus in sacris ædibus adhibitur, says Censorinus *De Die Natali*, cap. 12. Again, Ovid (*Fasti*, lib. iv.)

> Temporibus veterum tibicinis usus avorum
> Magnus, et in magno semper honore fuit;
> Cantabat fanis, cantabat tibia ludis,
> Cantabat mœstis tibia funeribus.

Also, Horace (Carm. III. xi., lines 3 to 6),

> Tuque, testudo, resonare septem
>   Callida nervis,
> Nec loquax olim neque grata, nunc et
> Divitum mensis et amica templis.

Page 58, last line but four. For "adding *an A*," read "adding *a vowel*."

Page 78, last line but three of the Greek. For ὀζειᾶν, read ὀξειᾶν, as in the fourth line above.

Page 79, note [b], line 2. ἁρμονίᾳ wants the iota subscriptum.

Page 82, line 16. For *diazeutic* read *diazeuctic*.

Page 92, line 20. After "notes" add "*in treatises on Greek music*."

Page 110, note [b], line 1 (in some copies). μεγαλοπρετὲς, read μεγαλοπρεπὲς.

Page 116, note [a], line 1 (in some copies). ἐτέρῳ, read ἑτέρῳ.

Page 117, line 11. The "15, 16" refers to pages in *Introductio Harmonica*, attributed (erroneously) to Euclid.

Page 118, line 2. For *sēmeioi mousikoi*, read *sēmeia mousika*.

Page 121, last line but five. For *pentatonic*, rather read *pentaphōnic*.

Page 132. In referring to Meibom's mistakes in his Conjunct Greek scale, in "notes upon Euclid," p. 63, I have not explained where they are wrong. He treats *Paramese* and *Trite* as if two separate strings, instead of one and the same under either name. So that *Mese* and all other names below it in the scale are in wrong places. They should be moved up one degree, and *Hypate* should be added at the bottom of the scale. See p. 96.

2 f

Page 144, note [b]. For "tels *qui*," read "tels *que*."

Page 144, line 10. For "different passages," rather read "a different *kind of passage*."

Page 145, note on Plato's πυκνότης and μανότης. Parallel passages, which further elucidate the musical use of these words, will be found in Claudius Ptolemy's *Harmonica*, cap. 3, lib. i, p. 6, fol. beginning on line 4, and again at p. 7, line 1.

Page 180, lines 1 and 2. Delete the hyphen between *ha* and *koupha*.

Page 196, line 8. Before "Harmonic B flat," add "*interval between C and*."

Page 196, line 9. For "the key-note," read "the *interval between that B flat and the* key-note."

Page 203, line 18. Hyphen misplaced. It should be to quarter-tones."

Page 226, note [a], line 6. After "diese," add "sind aber viel weniger scharf als die ersten engeren Intervalls," and in line 7, "sollte," not "solte."

Page 228, note, line 11. For "überbringen," read "übergingen."

Page 229, line 10. For "as attribute," read "as *to* attribute."

Page 251, line 23. For "*Fifth*," read "*fifth Octave*."

Page 264, last line but three. For "once seeing," read "to see once."

Page 276, line 18. For "like a trumpet," read "like *the bell end of* a trumpet."

Page 277, line 4. No broad, general rules can be given as to the degree by which increase of diameter will lower pitch in large organ pipes. Pitch is affected both by the size of the tube and width of slit through which air is admitted into the pipe at its lower extreme; also by the height and by the size of the embouchure, of which the sharp, wedge-like edge, called the lip, forms the upper part. The wind must be directed against that cutting edge. Again, length and width must vary according to the quality of tone to be produced, and according to the weight of pressure upon the windchest. Lastly, pitch is affected by contact with wall or roof. A 32 feet pipe, with 16 vibrations per second, creates, according to computation, a sound-wave of not less than double its own length. All width, which is in excess of due mathematical proportion to other pipes of the series, changes the quality of tone. Although the nominal 32 feet pipe of an organ is often practically but 28 feet 6 inches in length, Mr. Thomas Hill, the celebrated organ-builder, informs me that this diminution in length is attended by sacrifice of true musical quality of tone. His words are:—"The diameter of pipe which produces the exact 32 length is 15 inches, and this, extended upwards, is found to produce the most pure and agreeable tone in a diapason." Herein science and practice are therefore agreed; but there are variations between them which have not yet been satisfactorily accounted for. If we take two hollow tubes, such as Pan's pipes, of equal length, but the diameter of the one a quarter, and the other of three eighths, of an inch, they will produce the same note; the larger only requiring more breath to sound it. Indeed, the practical limit to width, in pipes blown by the mouth, is the too great exertion required to sound those of large size. But, in the case of horns, Mr. Carte, and his foreman, Mr. Charles Goodison, who makes

the scales for the brass instruments of the firm, inform me that, if it is desired to enlarge a tenor horn so as to acquire a baritone quality of tone, the tube of the former being 6 feet 6 inches in length, will only be shortened by about *one* inch, although the diameter is increased by several sizes. And yet, on the other hand, there will be a variation of an inch and a half in the length of two horns of small size, to produce the same note from both. The actual scale for horns having two thirds of cylindrical tube and the lowest third of conical form, ending in a bell, is as follows :—

Tube, ½ inch in diameter, length, 40¼ inches, sounds A♮.
Tube, 7-16ths of an inch in diameter, length, 41¾ inches, sounds A♮.

Difference of form in the two cones may be one cause of the variation, for the more dilated the cone, the flatter the pitch. But there are so many bearings in these cases that the subject is one of considerable difficulty, unless science will step in. It is a pretty problem, but not one to be solved here at Oatlands, where there is not, perhaps, a brass instrument within a mile. And yet anyone might practise the horn in a drawing-room, if he would but have a bell to take on and off. The most skilled manufacturers of pipes still act more by experience than by any precise laws. In addition to Mr. Hill, Mr. Carte, and Mr. Goodison, whose authorities I have already quoted, I have to acknowledge practical information, kindly given to me by Mr. Kemp, and through him, Mr. Bryceson; also by Mr. Bishop, through the kind intervention of Mr. Griesbach.

Page 289, note [b], last line but four. For "plain," read "plane."

Page 305, note [b], last line but seven. For *ὡς περί*, read *ὁς περὶ*.

Page 310, note [a]. On further consideration, I take Plutarch's meaning to be that the Psalmos and the Phorminx make Octaves and harmony when they are played together—not each separately. The Phorminx was for a man's voice, and it had ordinarily but ten strings. The vocal Psalmos was often accompanied by instruments of a feminine character, which would be about an octave higher than the Phorminx. Athenæus cites a passage from Telestes in which he refers to the acute sounds of a *Pēktis-Psalmos* employed for hymns in the Lydian mode. That mode in itself was two whole tones higher than the Dorian.

τοὶ δ' ὀξυφώνοις πηκτίδων ψαλμοῖς κρέκον
Λύδιον ὕμνον.—(Athenæus, xiv., 626.)

Page 351, line 6 of the Latin. For "prætermitt*ero*," read "prætermitt*am*."

Page 353, line 1. For "d*o*lphini," read "d*e*lphini."

Page 364, end of note [a]. For 1164, read 1864.

From the marble statue of a Satyr, or Faun, with cymbals, of about the First Century, now in the British Museum. The statue is known as the Rondini Faun.

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